CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL
Director

GEORGE T. McCOY
State Highway Engineer

KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 January-February Nos. 1, 2

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

U.S. Road Funds

The History of Federal Aid For Highways in California

By R. F. REYNOLDS, Assistant Office Engineer

INTEREST IN FEDERAL AID

In an article in the November-December issue of *California Highways and Public Works,* Director of Public Works C. H. Purcell briefly summarized the history of federal aid allocations to the California State Highway System. The article attracted so many inquiries that it was deemed worth while to present a complete story of federal aid in this issue of the magazine.—*Editor.*

INCREASED AUTOMOBILE PRODUCTION and use in the United States between 1910 and 1915 brought an increasing demand for more and better highways.

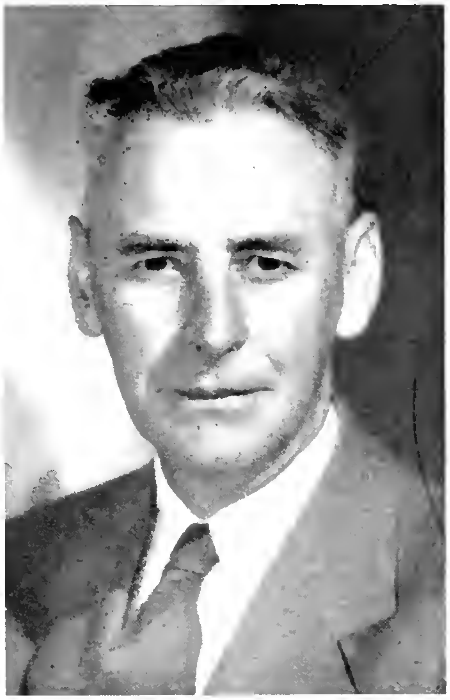
The growth of the country was spreading back from the railroads and farmers wanted better means of reaching the nearest towns and railroad stations than were provided by local existing roads, most of which were dusty in summer and bog holes in winter.

The financing of the improvement of these roads by local and state bond issues had become such a drain on local resources that the states turned to the Federal Government for financial assistance.

Act Passed in 1916

The Congress of the United States, recognizing its responsibility to the states in the construction of these rural roads, passed the Federal Aid Road Act which became law on July 11, 1916. Their authority was Section 8 of the Constitution of the United States, which granted power to the Federal Government to establish post offices and post roads for the transportation of the mails.

This Federal Aid Road Act provided for the improvement of any rural road over which the U. S. mails then were or might thereafter be transported, a provision so broad as to include almost any rural road. However, it prohibited expenditure of federal funds on any road or street within the built-up portion of any place of more than 2,500 population. It appropriated a total of $75,000,000 to be spent over a five-year period and permitted federal participation in payment for the roads constructed up to 50 percent of the total cost or a maximum participation of $10,000 a mile, the remainder to be paid from state funds.



R. F. Reynolds

Formula Used

The act prescribed a formula to be used in apportioning the federal money to the states. The formula employed ratios, each with identical weight, which were the percentage relations of the area, population, and post road mileage of each state to the total area, population, and post road mileage of the United States.

California's share of this five-year period appropriation was $2,282,-727.19.

The Office of Public Roads and Rural Engineering, a part of the Department of Agriculture, administered this federal money.

States' Initiative

This original act preserved for the states the initiative in determining what roads were to be built and type of improvement. It authorized the Secretary of Agriculture to approve or reject the states' proposals. It placed immediate supervision of construction in the hands of the state highway departments but required that such construction must be accomplished in accordance with sound engineering practices. This it did by withholding final federal payment on a project until it had passed federal inspection. In addition, it required that the states advance their own funds and pay for the work undertaken. Finally, it imposed upon the states the duty of adequate maintenance of the completed federal aid project.

The projects were identified in each state numerically, the first improvement being number 1, with the prefix F. A. P.

First Federal Aid Project

The first federal aid project undertaken by California under provisions of the 1916 act was the improvement in Contra Costa County between the southerly boundary and Richmond, a distance of 2.55 miles on State Route 14, Section A, which was completed in July, 1917, at a cost of $53,938 with federal aid payment in the amount of $24,244.56.

World War I seriously handicapped California and other states in expeditiously obligating the federal aid provided by the initial 1916 act.

As a stimulus to increase highway construction following the armistice, Congress provided an appropriation of $200,000,000 of federal funds for highway construction and increased the federal share from $10,000 to $20,000 a mile. This was accomplished under the Post Office Appropriation Act of February 28, 1919. This act also provided for the distribution to the states of surplus war material, equipment, and supplies which could be utilized

for federal aid highway improvement and subsequent maintenance operations thereon.

MacDonald Made Chief

To efficiently supervise this increased federal aid program the Office of Public Roads and Rural Engineering was reorganized into the Bureau of Public Roads with Thos. H. MacDonald from the Iowa State Highway Department as the head. His title was Chief of Bureau.

California was apportioned the sum of $6,101,627.38 by the act of 1919.

With these additional federal funds and the lifting of wartime restrictions the provisions of the Federal Aid Road Act were promptly put into practice and an outstanding defect of omission in the federal legislation was quickly discovered. The rather loose provision for the improvement of rural mail routes resulting in their construction at widely scattered locations precluded the possibility of any reasonable completion of connected improvements. The jigsaw pattern of these mail roads while designed to provide mail delivery to our rural population did not necessarily follow those roads on which traffic was concentrating. The need for a system of roadway development was eminent.

Congress Acts

This condition was promptly remedied by Congress with the passage of the Federal Highway Act of 1921 which provided for the selection of a system of federal aid routes and limited the expenditures of available and future federal aid apportionments to these routes.

The system, to be designated by the highway departments of the states, was limited to 7 percent of the total rural road mileage of the state as existing at the time of passage of the act.

The California Highway Commission determined that there were 70,000 miles of rural roads and in February, 1922, submitted its initial designated federal aid system of 4,468 miles, leaving a balance of 432 miles to be subsequently selected. This initial "Seven Percent System" in California, as it was commonly referred to, was composed of highways interstate and intercounty in character and included the most important state highway routes then in existence.

> **WHAT FIGURES MEAN**
>
> The figures contained in this article relative to financial participation on the part of the Federal Government in California highway construction are confined entirely to state expenditures reimbursable with federal funds.
>
> No attempt has been made at this time to cover direct expenditure for road construction which have been made over a period of years by federal agencies from funds allocated for expenditure in California for Forest Highway and Federal Lands purposes.

Public Lands Legislation

Large areas in the western part of the United States are composed of public lands, and Congress, realizing the Federal Government's responsibility in the improvement of federal aid roads that might be built therein, provided for an increased ratio of federal participation in such states. The Federal Highway Act of 1921 stipulated that, in any state containing unappropriated public lands in excess of 5 percent of the total area of all lands in the state, the federal share of the costs of improvement would be increased by 50 percent of the percent of unappropriated public lands in that state. California, with approximately 18 percent unappropriated public lands, benefited to the extent of an additional 9 percent resulting in the federal share of participation in the cost of a federal aid project of approximately 59 percent, with a maximum limitation of federal payment of approximately $23,600 per mile.

Adequate Powers for States

Perhaps one of the most important features of the Federal Highway Act of 1921 was the strengthening of the provision requiring a state to have an adequate state highway department in order to avail itself of the federal aid provided. The act required that the state highway department must have adequate powers and be suitably equipped and organized to discharge to the satisfaction of the Secretary of Agriculture the duties required thereunder. Rules and regulations were established by the Secretary of Agriculture to carry out the provisions of the act and serve as a guide to the proper administration of federal funds.

The Federal Highway Act of 1921 was so sound in principle that it has served as a basic law for governing the federal aid program for over a quarter of a century.

Matching Funds

With the Fiscal Year 1923 Congress began the practice of authorizing appropriations for a succeeding period of two to three fiscal years which has enabled the states to plan ahead and provide enabling state legislation for procuring the anticipated necessary state matching funds. Aside from authorizing and appropriating federal sums during the period 1923-30, no attempt was made by Congress to alter the conditions governing the expenditure of these funds except in respect to the maximum federal participation per mile. The mileage limitation was changed in 1923 from $20,000 to $16,250 per mile for that year and $15,000 per mile thereafter and in 1930 it was changed to $25,000 per mile. Since California is a public land state these limits of federal payments per mile were somewhat higher, ranging from $17,700 to $29,500.

All limitations with respect to payments on a mileage basis were removed by a subsequent act of Congress on June 18, 1934.

Rapid Progress in California

During the years 1921-33 California made rapid progress in the improvement of the State Highway and the Federal Aid Highway Systems. The revenue from motor vehicle license fees and gasoline tax was being collected each year in greater sums. They were expended on the Federal Aid System as often without as with matching federal funds.

The modest federal appropriations comprised a small part of the total funds expended on the system but the principles and standards developed on the federal aid projects were applied in the entire state highway construction expenditure. During the period 1921-33 the State of California

. . . *Continued on page 56*

Freeway Ups Business

North Sacramento Shows Growth

By W. STANLEY YOUNG, Headquarters Right of Way Agent

The contention of land economists and informed merchants that the removal of through traffic from a local business district by the development of a freeway results in real benefit to business establishments effected appears to be justified by an exhaustive survey in North Sacramento just completed by the Division of Highways.

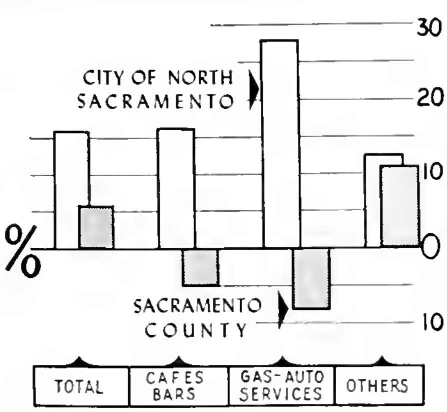
Average daily traffic through North Sacramento dropped off 44 percent after the North Sacramento Freeway by-passing the city opened, but the total volume of business in the district in the ensuing two-year period jumped upwards 31 percent.

The North Sacramento Freeway was opened to traffic in October, 1947. It carries the very heavy volume of traffic using U. S. 40 and U. S. 99-E, the main route northerly along the east side of the Sacramento Valley to Oregon, and also the transcontinental route running easterly from San Francisco through Sacramento to Reno, around North Sacramento's prosperous business district.

200 Businesses Involved

The 4.1-mile long freeway replaced approximately the same length of state highway which had served more than 200 abutting businesses and carried all the north-south and east-west through traffic, as well as almost all the commuter traffic between the state capital and the outlying communities and residential developments to the east and north.

CHANGE IN *number* OF BUSINESSES AFTER FREEWAY OPENING



TRAFFIC

In the year just prior to opening of the freeway, the average daily traffic through North Sacramento was 38,950 vehicles, which was all the traffic going into the state capital on the highway from the north. During the year immediately following opening of the freeway, the average daily vehicular traffic dropped to 21,857 in North Sacramento, which was, as mentioned before, a 44 percent decline.

To determine just what actual effects this drastic reduction in vehicular traffic through North Sacramento had on abutting business and property values, the Division of Highways has conducted a three-phase investigation as follows:

1. The retail sales of all the businesses abutting the by-passed route have been tabulated and compared to the county figures in each business class over a four-year period.
2. All sales of real esate abutting the former state highway were investigated and verified and an analysis of the "before and after" sales made.
3. Each retail business and motel operator was interviewed in a poll concerning his opinion of the effects of the freeway on his business and also on real estate values.

GROSS SALES PHASE

Whereas the effects of the freeway south of the City of Fresno were most apparent in the change of land use and subsequent rise in real property values, (November-December issue of *California Highways and Public Works*), the effects of the North Sacramento Freeway on by-passed business and property values are most clearly reflected by our analyses of the gross retail sales.

Three principal reasons for the importance of this particular phase are:

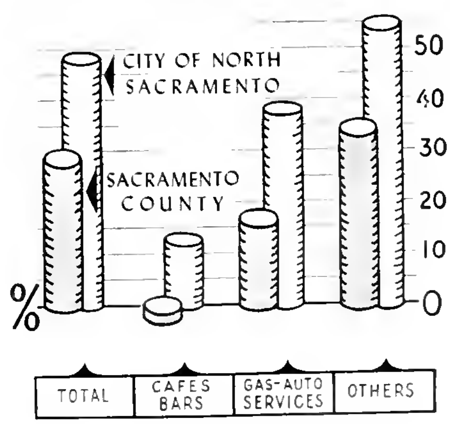
1. The installation of the freeway has not resulted in a change in land use, but rather a more efficient operation of the same uses along the by-passed section.
2. The large number of businesses available for study made it possible to eliminate the personal factors of business fluctuations such as managerial ability, and advertising site value of a particular location.
3. A definite basis of comparison of gross volume of retail sales for exactly the same period is available for the various business types.

Period of Comporison

A "two-year period before" and a "two-year period after" have been selected because they provide the widest base for which complete sales figures are available for both North Sacramento and the county, and the eight quarters of each period are exactly comparable inasmuch as the freeway was opened at the beginning of the fourth quarter of 1947, thus both periods begin with a fourth quarter and end with a third quarter.

This is how the comparison looks in percentages. While North Sacramento registered an increase in over-all volume of retail business—of 48.5 percent

CHANGE IN *gross* RETAIL SALES AFTER FREEWAY OPENING



and a gain of 16 percent in number of businesses in operation, the entire county's average increase in retail sales was slightly more than 27 percent and the number of retail businesses increased less than 6 percent.

Not only did the rate of increase in number of business establishments in North Sacramento considerably exceed the county-wide rate of increase, but the increase in gross volume of business was so much greater than the county rate of increase that the volume of all business per establishment in North Sacramento showed a gain of 28 percent as compared to less than 10 percent increase in the county during the same period.

Better Than County

The accompanying graphs may picture more clearly just how much better all retail business classes have fared than the same classes throughout the county.

Most informed people believe that removal of highway traffic from a downtown business district usually results in a betterment to merchandising establishments such as department stores, grocery stores, dry goods stores, and other businesses catering primarily to foot traffic, principally because of the better parking conditions and easier pedestrian movement.

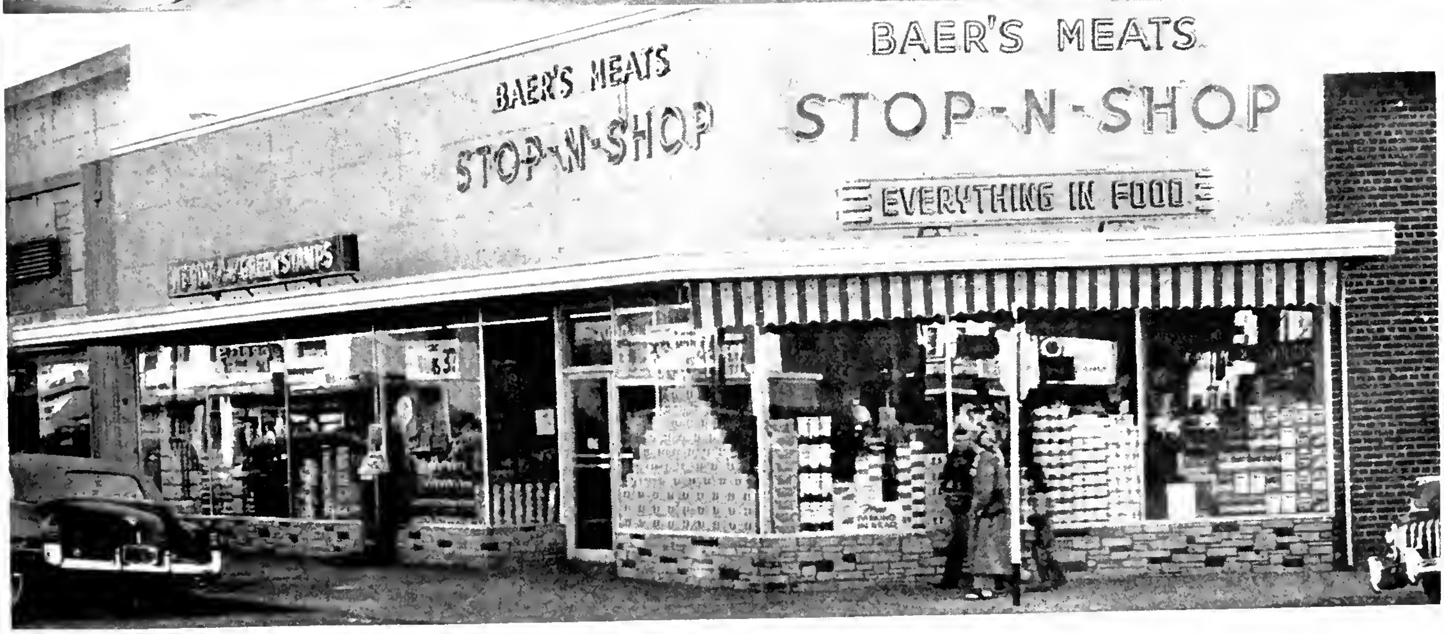
The accompanying photographs of some of the businesses opened since the freeway show the culmination of the owners' confidence in the beneficial effects to be realized through traffic removal.

Their opinions were justified as the greatest sales increase, and apparently the greatest benefits, due to the freeway, were tabulated by the classification, "All Other Businesses." This group includes such enterprises as department stores, apparel stores—in fact, all the miscellaneous retail businesses feeding primarily on pedestrian traffic.

City Business Benefited

The volume of business of these establishments increased 54½ percent while the county-wide increase was a

Aerial view looking north from the southerly junction of the former state highway through the City of North Sacramento and the freeway. The tangent on left of photo is the area under study in this report. The bypassed route also has a northerly junction with the freeway near the upper left hand corner of photograph



These photos are indicative of the type of business establishments being constructed in North Sacramento on the former state highway subsequent to opening of the freeway

One of the typical advertising signs erected by motel owners near North Sacramento to divert that portion of freeway traffic wishing to utilize their facilities

little less than 33 percent. The number of such enterprises increased at about the same rate as the county, so that the percentage increase in average volume per business was almost double the county average.

It was learned in our opinion poll that many of the people who held little doubt as to the beneficial effects of the freeway on the certain classes of businesses mentioned above, expected this traffic diversion to prove fatal, or to cause at least a considerable loss to many businesses such as service stations, auto supply stores, cafes and bars, all of which cater largely to the motorist. Our study of North Sacramento tends to refute this expectation.

Comparative Figures

In comparison of the gross volume of sales of service stations and auto supply stores in North Sacramento along the by-passed route to the gross sales of the same types of business in the county, there was an increase of almost 38½ percent in North Sacramento while the same types of business in the county registered a gain of slightly more than 15 percent. In the same two-year period, after the freeway's opening, the number of service stations and auto supply stores increased 28 percent in North Sacramento over those existing at the time of the opening compared to a drop in number of almost 8½ percent in the entire county.

Cafes and bars along the by-passed route showed a gain of approximately 13 percent in gross sales volume, compared to a county-wide loss in sales volume of 1½ percent. At the same time the number of cafes and bars increased more than 16½ percent and the number in the county decreased 5 percent.

All Classes Gained

Summarizing the factual data developed in this phase of our study, even without the corroboration of the following phases, it is readily apparent that all classes of retail business abutting the by-passed highway have been benefited by the freeway development. In every case their gross sales have exceeded the average throughout the county in the two-year period following the freeway opening.

REAL ESTATE PHASE

There were 66 recorded sales of real estate abutting the former highway during the period between January 1, 1945, and November 1, 1949, of which 23 were of vacant property.

Because of the difficulty in apportioning the total selling price between land and improvements on improved properties to obtain an estimate of the land value at the time of sale, the improved property sales have proved of little worth unless the same property had been subsequently resold without alteration.

The wide variation in values along the four-mile superseded route and the lack of proximity to each other of the 23 vacant property sales rendered them also of little value unless resold during the period studied.

Therefore, the only real property sales which permit an accurate analysis are those properties which were sold during our period of study, before the freeway opening and again after the freeway opening, without alterations or additions having been made.

Before and After Sales

There were resales on three improved and five vacant properties which fell into this classification. These we used for a "before and after" basis of comparison.

All but one of the eight "before and after" sales indicate an increased value. All five of the "before and after" sales of vacant property showed a substantial increase in sales price, that increase being 30 percent, 50 percent, 38 percent, 60 percent and 230 percent, respectively.

The only property which resold for a lower price than the previous transaction, was an improved property, the loss being 6 percent. The seller stated that he made a poor buy due to anticipation of high rentals based on shortage of improved business properties in 1946, the date of his purchase. Because of the age and poor condition of the improvements, he was forced to take a slight loss on the property in 1948.

The other two improved properties for which we have a "before and after" value show increases of 50 percent and 55 percent, respectively.

Increasing Property Value

A study of all the sales of vacant property along the area under consideration indicates an increasing front-foot and square-foot value. Prior to the freeway, the highest priced sale in the

downtown business area was on the basis of $220 per front foot. The average of all vacant property sales during that period was approximately $160 per front foot.

After the freeway opened, the highest price paid for downtown business property was $320 per front foot, while the average of all the vacant property sales was $290 per front foot.

It is significant that there were no vacant property sales subsequent to the freeway opening which resulted in a lesser price than was paid for the same property prior to the freeway, and that there are no known offerings for sale of previously-sold vacant properties for a price less than the original sale price.

A brief description of each of the "before and after" sales of the same property which are pictured in the graph on page 8 is as follows:

Sale No. 1.—Vacant, irregular-shaped corner lot on Del Paso Boulevard near heart of business district. Frontage three streets. Modern store building to be erected soon. Increase of more than 30 percent.

LATEST COST INFORMATION

The article on "High Costs" which appeared in the January-February, 1949, issue and the article on "Cost Index" in the July-August, 1949, issue of *California Highways and Public Works* have created so much interest in the ever changing cost picture that the authors of these articles have summarized the results of their continued study of highway construction costs.

California highway costs showed a steady downward trend during 1949 as shown by the California Highway construction Cost Index for the year. (1940 Index = 100)

First quarter	200.4
Second quarter	195.7
Third quarter	187.9
Fourth quarter	178.8

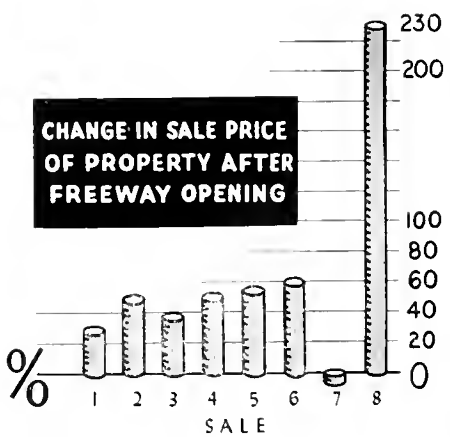
The fourth quarter index is 17.5 percent below the postwar peak of 216.8 reached in the first half of 1948 and is 4.8 percent below the third quarter.

The change in average bid prices for eight major contract items during 1949 is shown by a comparison of the prices paid during the last half of 1948 with those paid during the last quarter of 1949:

Item	Average Price Unit	Last half 1948	Fourth quarter 1949	Change
Roadway excavation	Cubic yard	$0.52	$0.43	—17.3%
Crusher run base	Tons	2.64	2.55	—3.4%
Plant-mix surfacing	Tons	4.80	3.78	—21.3%
* Asphalt concrete	Tons	7.00	3.50	—50.0%
Portland cement concrete pavement	Cubic yard	14.01	12.66	—9.6%
Class "A" Portland cement concrete (structures)	Cubic yard	49.08	44.54	—9.3%
Bar reinforcing steel	Pound	0.103	0.078	—24.3%
Structural steel	Pound	0.131	0.092	—29.8%

* *Only a very small quantity (14,870 tons) was included in contracts awarded in 1949.*

The main portion of the business section through North Sacramento showing normal utilization of the street subsequent to the development of the freeway and without the congestion formerly suffered when used by through traffic



Sale No. 2.—Vacant property at time of both sales. On Del Paso Boulevard, two blocks southwest of heart of business section. Now improved with modern store building. Increase of 50 percent.

Sale No. 3.—Vacant property on El Camino Avenue near railroad underpass. Now house trailer sales and parking. Increase of approximately 38 percent.

Sale No. 4.—Property improved with cheap frame store building, located on Auburn Boulevard, across from railroad tracks. Increase of 50 percent.

Sale No. 5.—Improved commercial property near railroad underpass on Auburn Boulevard. Small amount of improvement between sales. Increase approximately 55 percent.

Sale No. 6.—Vacant at both sales. Located on Del Paso Boulevard, at approximately four blocks from center of retail business district. Now improved with modern auto salesroom. Increase approximately 60 percent.

Sale No. 7.—Improved commercial property located on Del Paso Boulevard approximately five blocks from center of business district. Improvements are converted old dwelling with store and apartments. First sale at time when there was scarcity of commercial improved properties. Paid premium price. Loss of approximately 5½ percent.

Sale No. 8.—Commercial property improved with worthless old sheds only, located on El Camino near Del Paso. Original sale to adjoining property owner, making total holding four lots. Subsequently resold all four lots as one parcel. Pro-rata portion of original lots estimated one-half total selling price. Increase 230 percent. Original two lots now listed at the same price as pro-rata share of second price. Other two lots now improved with modern store.

OPINION POLL PHASE

There is a total of 224 businesses along the 4-mile by-passed route, of which 158 are licensed retail establishments. Service stations number 24, and cafes and bars, 28. There are nine motels including auto courts.

This opinion phase was made to obtain the operator's opinion of whether or not the freeway was detrimental to his business. No attempt was made to utilize his estimate of gain or loss on a percentage basis, as this was handled with greater accuracy in the first phase. The results were as follows:

Type of retail business	Number of businesses			
	Total	Claiming loss due to freeway	Showing a loss due to all causes	In tenancy when freeway opened
Service stations	24	7	6	8
Cafes and bars	28	7	6	10
All other businesses	106	15	31	76

Tabulation Analyzed

This tabulation can be analyzed along the following lines:

Of the 24 service stations listed, only eight, because of the fact that their tenancy extended through the period before and after the opening of the freeway, were in a position to have a definite opinion of the effects of the freeway upon their property. Of those eight, all but one claimed a loss due to freeway construction, whereas actual figures secured for the development of the gross retail sales phase, show that only six suffered a loss, and this due to all causes.

This chart also indicates the comparatively high turnover rate in this type of business and indicates that only one-third of the present operators were in tenancy at the time the freeway opened.

Cafes and bars followed approximately the same pattern. Of the 10 operators who were in a position to have opinions on the business change for this period, seven claimed loss due to the freeway development, whereas their actual figures show that six of this class of business actually showed a loss.

Although the tenancy apparently has been short-lived along the route studied, these classes of business (service stations, cafes and bars) have a somewhat lower turnover rate than the state-wide average, which is 44 percent annually for all roadside businesses, according to Barrow's *Economic Guide*.

In the "All Other Businesses" classification, the stability is immediately apparent. Only 15 of the 76 tenants in operation at the time of the freeway opening claimed a loss due to freeway construction.

Among the 31 businesses showing an actual loss are such businesses as the six second-hand pipe machinery and surplus equipment stores, in which the fluctuation in business has no relation to the freeway in any manner. It was during this period that the lumber and mining operations in this vicinity took a drastic cut from their wartime production, and that the release of materials again made new equipment available. This loss was suffered by all like businesses throughout the State.

MOTELS

It was necessary to study the motel class of business separately from the retail business analysis because no actual gross income or occupancy figures are available for a comparison with the opinions secured.

Therefore, we interviewed the motel owners with establishments which abut upon and are visible from the highway near the northeasterly end of the freeway. These interviews were compared to the statements of the motel operators along the by-passed route. It was found that motel owners in the two locations held opposite views concerning the freeway effects on the by-passed route.

Six of the nine motel owners along the by-passed route believed the freeway was detrimental to their business and all nine believed the motels on the highway to be consequently in a much better position than they because of being in plain view of and accessible from the highway.

Differing Opinions

The motel owners along the highway held that the North Sacramento owners' location close to shopping centers and now relieved of highway noise, combined with the large advertising signs maintained by the motel

. . . *Continued on page 33*

Earned Rest

Edward Hyatt Retires From Post of State Engineer After 35 Years of Service

Director of Public Works C. H. Purcell on January 11th announced he had accepted with regret the request for retirement of Edward Hyatt, State Engineer and Chief of the Division of Water Resources, effective February 1st. Hyatt told Purcell he was requesting retirement at this time on his doctor's advice.

EDWARD HYATT—1950

Hyatt has been in the state service for more than 35 years and has been State Engineer of California for the last 22 years. He served the State of California from 1914 to 1950 under eight Governors, from Hiram W. Johnson to Earl Warren, and held appointive positions under Governors Richardson, Young, Rolph, Merriam, and Olson. During the remainder of his state career he has been under civil service.

Purcell also announced that A. D. Edmonston, Assistant State Engineer since 1945, will succeed Hyatt.

Praise From Purcell

In approving Hyatt's application for retirement Purcell said, "I have consulted with Governor Warren on this matter, and it is with deep regret we have approved Ed Hyatt's application for retirement. I know of no other state official who will be so sorely missed. For the last quarter century he has been a leader and mainspring in the development of our California water resources and particularly the Central Valley Project. Without Hyatt's steadfast purpose we would not have the Central Valley Project under construction today.

"He has devoted the major part of his life to solution of our problems of water conservation, a subject of vital importance to California, and is recognized nationally as a leader in his field. Were it not for the splendid organization he has built in the State Division of Water Resources we would not be able to carry on. I am sure Mr. Edmonston, his successor, who has shared the administrative work of the division with Hyatt for the last five years, will prove a competent and worthy successor to the position of State Engineer.

Hyatt's Career

Mr. Hyatt's illustrious career of 35 years in the State's service parallels in part and continues that of his father who served as State Superintendent of Schools from 1906 until 1918.

In 1914 Ed Hyatt accepted employment with the California Highway Commission and thus began his long record of state service. He transferred to the State Water Commission in 1916 and that was the year that marked his introduction to those water problems with which he has ever since been on intimate terms. In 1924 he was promoted to Chief of the Division of Water Rights, successor to the State Water Commission. In 1927 he was appointed State Engineer and Chief of the Division of Engineering and Irrigation. He was the fifth State Engineer and has held the office many years longer than any of his predecessors. In 1929 the Division of Engineering and Irrigation and the Division of Water Rights were consolidated into the Division of Water Resources, under the Department of Public Works, with the State Engineer as chief.

EDWARD HYATT—1914

Many Activities

The activities which come under the Chief of the Division of Water Resources are many and varied. The regular functions of the division relate to appropriation of water, adjudication of water rights, watermaster service, supervision of use of water of Sacramento and San Joaquin Rivers, supervision of construction and maintenance of dams, maintenance and operation of Sacramento River Flood Control Project. Special activities of the division include investigations of surface and underground waters, construction projects carried on in accordance with special legislation or at the request of other state agencies. In addition to the foregoing the division cooperates with the Federal Government in programs involving stream gaging, snow surveys, irrigation investigations and topographic mapping.

Besides his duties as Chief of the Division of Water Resources Hyatt had many duties which devolved upon him as State Engineer. For instance he was executive officer of the Water Project Authority, the state agency responsible for development of the Central Valley Project. He was secretary and engineer of the State Water Resources Board which was created in 1945 to carry out the policies of the State with regard to flood control and water conservation matters. He was also a member and chairman of the California Districts Securities Commission, chairman of the State Irrigation Board and a member of the State Soil Conservation Commission.

Native Californian

The retiring State Engineer early in life was given a preview of most of the problems he was to encounter later. A native Californian, he grew up in Riverside County where water was scarce and the desert was near. His first engineering employment was with the United States Geological Survey, when he and the crew he was with mapped much of the desert regions and high Sierra. In those days surveys were made by small parties of men with a pack train of mules. They worked from daylight until dark and sometimes covered as much as 50 miles a day. Much of this work was done with the late Colonel Robert B. Marshall, Chief Topographer of the Geological Survey, who conceived the plan which eventually became the Central Valley Project. Marshall's counsel to his young aide served as inspiration to Hyatt in later years when he directed the studies which made Marshall's "wild engineering dream" a reality.

State Water Plan Surveys

Hyatt directed the surveys which led to development of the State Water Plan and the Central Valley Project. The State Water Plan has formed the basis of the entire water conservation program in the State since it was presented in 1931, and the Central Valley Project, which it proposed for initial construction, is now in an advanced stage of construction.

As executive officer of the State Water Project Authority it became Hyatt's duty to carry on the negotiations with the Federal Government, which were successfully culminated in the authorization by President Franklin D. Roosevelt for the Bureau of Reclamation to build the Central Valley Project.

Construction of the project now is nearing completion, but through many years it seemed only a will-o'-the-wisp venture too complex and vast for any agency, state or federal, to undertake. As a matter of fact, the Central Valley Project is the greatest reclamation project ever conceived by man.

During the long dark years before it became a reality many supporters of the project lost all hope of ever seeing it built. State administrations came and went, but as State Engineer and Executive Officer of the Authority, Hyatt never lost faith, never ceased working, nor deviated from his purpose of bringing this project into reality.

Edward Hyatt—His Professional Career

1908-1911, intermittently, topographic surveying, with U. S. Geological Survey.

1912-1914, with San Joaquin Light and Power Corporation, in charge of irrigation developments in San Joaquin Valley.

1914, Engineer, California Highway Commission, first state work (under Governor Hiram W. Johnson).

1916, transferred to the newly formed State Water Commission, which took charge for the State of water rights in California. After six years as engineer for the Water Commission, appointed on September 1, 1922, by A. B. Fletcher, Director of Public Works, with the approval of Governor Stephens, to the office of Deputy Chief of the Division of Water Rights, which division was the successor to the State Water Commission.

In 1924 appointed by Governor Richardson to the office of Chief of the Division of Water Rights, Department of Public Works.

In October, 1927, appointed State Engineer by Bert B. Meek, Director of Public Works, with approval of Governor Young.

In August, 1929, the Division of Water Resources succeeded to the duties of the former Divisions of Water Rights and Engineering and Irrigation. At that time Mr. Hyatt was appointed by Director Meek as State Engineer and Chief of the Division of Water Resources, continuing to the present time.

BOARDS AND COMMISSIONS

In addition to duties as State Engineer he is presently serving ex officio on the following statutory boards and commissions:

- Chairman and Member State Irrigation Board.
- Member California Districts Securities Commission.
- Member State Soil Conservation Commission.
- Member Water Pollution Control Board.
- Executive Officer, Water Project Authority of the State of California.
- Engineer and Secretary, State Water Resources Board.

Also, while State Engineer he has served on the following appointive commissions:

- 1929—Secretary, Hoover-Young Commission on Central Valley Project.
- 1930—Member California Irrigation and Reclamation Financing and Refinancing Commission.
- 1931—Member Lake Tahoe Interstate Water Committee.
- 1931—Member Governor Rolph's Water Conservation Committee.
- 1932—Member Western States Water Policy Committee.
- 1935—Member Water Resources Committee of the National Resources Planning Board.
- 1939—Member State Reclamation Board.
- 1940—Member State Council of Defense.

PROFESSIONAL MEMBERSHIPS

Tau Beta Pi.
Sigma Xi.
American Geophysical Union.
American Society of Civil Engineers, Sacramento Section, Past President.
Western State Engineers Association, Past President.
Irrigation Districts Association of California.
National Reclamation Association.
National Water Conservation Conference.
National Rivers and Harbors Congress.
and numerous committees and boards concerned with water questions.

SOCIAL MEMBERSHIPS

Sutter Club of Sacramento.
Sacramento Lodge No. 40, F. and A. M.

BIOGRAPHICAL

Born July 21, 1888, San Jacinto, California.

Father—Edward Hyatt, native of Ohio, graduate of Ohio State University, who was State Superintendent of Public Instruction in California from 1906 to 1918, and who died in 1919.

Mother—Margaret Gill Hyatt, native of Ohio, and graduate of Ohio State, who died in 1923.

Married in 1916 to Delta A. Gorst. Two children, Mrs. Theodore C. (Dolly Margaret) Parks, and Mrs. Horace D. (Janice) McClure.

EDUCATION

Graduate Riverside, California, High School 1906.

Stanford University—Civil Engineering, between 1906-1912, A.B. and C.E. 1912.

In 1910 spent several months in Ohio State University, special course in civil engineering.

In 1920 received civil engineering degree from Stanford University.

Knows State's Water Problems

No other man in California has been so intimately connected with the State's water problems, nor knows them more thoroughly. Certainly no other man in California has been so instrumental in state and national circles in developing the Central Valley Project from a nebulous dream into a reality.

Edward Hyatt, for many years a member of the American Society of Civil Engineers, was one of the organizers of Sacramento Section and its second president. He was active also in formation of the Western States Engineers Association with membership composed of the state engineers of the 17 western states, known as the "Irrigation States." Two honor societies, Tau Beta Pi and Sigma Xi, have conferred membership upon him.

Edmonston, who will succeed Hyatt, has been with the State since 1924. Prior to his state service Edmonston spent 14 years in charge of location, design, and construction of various irrigation, hydroelectric, and municipal water projects in California. Projects with which he was identified included the South San Joaquin Irrigation District, American River Hydroelectric Project for the Western States Gas and Electric Company, Union Water Company of Oakland, Cordua Irrigation District in Yuba County, Excelsior Water and Power Company, and Sutter Butte Canal.

Edmonston Enters State Service

Edmonston first entered state service in 1924 as hydraulic engineer in charge of investigations and preparation of reports on water resources of California.

From 1927 until 1945 he was principal hydraulic engineer in immediate charge of the formulation of the State Water Plan, the preparation of plans for the Central Valley Project, and other investigations. Since 1945 Edmonston has been Assistant State Engineer, in which capacity he has been delegated to act for the State Engineer in administration of all activities of the Division of Water Resources and in performance of all duties conferred by law on the State Engineer.

A. D. Edmonston—His Professional Career

A. D. Edmonston, successor to State Engineer Edward Hyatt

Born in Ferndale, Humboldt County, California, November 12, 1886.

Education—

- Grammar schools in Humboldt County.
- Graduate Eureka High School 1906.
- Graduate Stanford University, A. B. in C. E., 1910.

Member American Society Civil Engineers.

Registered Civil Engineer, State of California.

Tau Beta Pi Engineering Fraternity.

Commonwealth Club.

Private, and Second Lieutenant of Engineers, World War I.

1910-1924—Employed on and in responsible charge of location, design and construction of hydraulic structures in connection with various irrigation, hydroelectric and municipal water projects in California, including dams, canals, and tunnels in irrigation structures for South San Joaquin Irrigation District, a 70,000-acre project in Stanislaus County; dams and canals on the American River hydroelectric project for Western States Gas and Electric Company; pumping plants and pipe lines in Oakland for Union Water Company, and complete irrigation system for Cordua Irrigation District in Yuba County. During this period, investigations and reports were made for Excelsior Water and Power Company and Sutter Butte Canal. Also was employed during this period as resident engineer on bridge and highway construction for Santa Clara County.

ENTERS STATE SERVICE

1924-1945—Entered state employment September 12, 1924. From 1924 to 1927 as Cost Estimator and then Hydraulic Engineer in charge of investigations and preparation of reports on water resources of California.

1927-November 1945. Principal Hydraulic Engineer and Deputy State Engineer in charge of water investigations, and other activities of the Division of Water Resources, and Acting Secretary of Water Project Authority of State of California. In direct charge of formulation of State Water Plan and plans for Central Valley Project. Supervision of expenditure of state funds in amount of $6,000,000 for flood damage repair work; supervision of preparation of plans and construction of water supply systems for state institutions and of ocean beach protective works; supervision of special water investigations; assisting State Engineer in general administration of activities of Division of Water Resources.

November 1945 to date. Assistant State Engineer delegated to act for State Engineer in administration of all activities of the Division of Water Resources and in performance of all duties conferred by law on the State Engineer.

U.S. 99 Improved

Between Klamath River and the Oregon Line

By F. W. HASELWOOD, District Engineer

A LONG NEEDED IMPROVEMENT on a section of U. S. 99 in Siskiyou County near the Oregon line has been completed.

The old highway ran through Hornbrook, a small trading point in northern Siskiyou County on the Southern Pacific. Prior to the coming of the railroad, the area was served by Henley, a settlement about one-half mile southwest, and just east of the new highway location. When the railroad was built in 1886, the construction was performed by Chinese coolie labor, some 4,000 being engaged using dump carts and wheelbarrows.

Hornbrook received its name from David Horn, the first settler in the area, and from whom the Southern Pacific acquired its right of way.

The first railroad engines were wood-burners. A woodshed 1,000 feet long was constructed at Hornbrook to store and protect the fuel. These engines were able to haul 18 cars up the grades of the Siskiyous.

The state highway came through Hornbrook in 1914. Prior to that time the old stage road went through Henley. Very little had been changed on the highway location since that time.

This section of the Pacific Highway immediately south of the Oregon-California line has long been a matter in which the Division of Highways took small pride. The alignment followed up Cottonwood Creek and its tributaries. Curves were frequent and sharp, grades were not excessive but grade changes were abrupt.

The over-all picture was that sight distance was limited to distances as low as 250 feet. The underpass at the Southern Pacific tracks was deficient in width and height. In other words, it was a road upon which speeds of over 35 miles per hour should be attempted only after a protracted period of fasting, prayer and meditation.

Then in the late thirties Oregon began to reconstruct its section of the Pacific Highway immediately north of the boundary. In order to meet this location, the Division of Highways built 1.84 miles in 1941 which connected to the present road just south and east of Hilt. This, taken in conjunction with the construction in Oregon, represented a real improvement but it made the deficiencies of the balance of the California section stand out more plainly.

UPPER—Old narrow underpass which was replaced by modern structure, lower photo

The division had made some surveys and investigation of this general location over a period of years. The best solution seemed to lie in proceeding from the end of the section constructed, southerly to a new grade separation in the near vicinity of the existing structure. The location emerged on a side hill steeper than could be used for highway purposes and to secure support, a long curve to the west was necessitated. The solution was not very satisfactory.

Finally, in 1942, the idea to abandon previous efforts and investigate a location for a new line and separation structure across a gulch and about 1,000 feet east of the previous tentative location was presented. A preliminary line down the valley was developed from the projected structure and appeared entirely feasible. The routine of location survey, soil investigation and structure plans were then begun.

When plans had reached the appro-

priate state, right-of-way negotiations were initiated. Though this was the first projected limited freeway in the district, the cooperation of the property owners permitted the acquisition of all the necessary parcels of land, with a single exception, within less than two months.

Plans, specifications and all the other items that enter into such operations, were completed so that the project was set up in 1944 as one of the postwar projects.

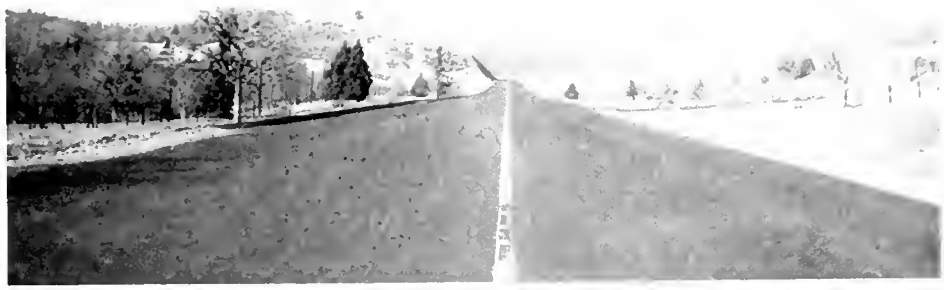
The contracts for grading and for structures on the project were advertised in September, 1947. Fredrickson and Watson were low bidders on the grading for $752,000 and Ted Baun on the structures for $382,000. The grading work was heavy, comprising almost 800,000 cubic yards of excavation, much of which was very hard rock. The structure contract included the Southern Pacific underpass and a 164-foot concrete bridge over Cottonwood Creek. Both contracts were completed late in 1948. In 1949 the surfacing contract on the project was awarded to A. Teichert and Son for $304,000. It has now been completed.

Early in November the people of Yreka, led by State Senator Randolph Collier and Richard Day, Secretary of the Yreka Chamber of Commerce, quietly contacted the citizens of their own community and the adjacent towns in Oregon concerning a celebration to mark the completion of the project.

The result was that a ribbon-cutting ceremony was staged at the underpass on November 21, 1949. Besides the people from Yreka, Fred Grumm, Deputy State Highway Engineer, represented the Division of Highways and a contingent came down from Oregon that outnumbered the Californians.

And so we now have about nine and one-half miles of highway immediately south of the Oregon line for which we no longer feel apologetic. The underpass is a beautiful structure; the first major improvement of its nature that southbound traffic encounters in California. The highway grades are long and sustained. Curves are flat enough so that minimum sight distance is 1,100 feet and their number has been reduced from 46 to 10. The driving surface is of a width to provide a feeling of adequacy. The acquired right of way is sufficient to allow for the addition of two more traffic lanes when traffic demands require them.

So if you want to go north on the Pacific Highway, just climb in the old bus and take off; it will not be necessary to serve a period of penance before starting.



UPPER—Old section of U. S. 99 in Siskiyou County. CENTER—Stretch of new realignment. BOTTOM—Site of old stage station at Henley

New Truck Route

City of Burbank Dedicates Million-dollar Highway

With state, county and municipal officials in attendance at the ceremony, the City of Burbank, on January 17th, dedicated the new $1,000,000 alternate truck highway which was constructed with funds contributed by Burbank, the Los Angeles County Road Department, the Los Angeles County Flood Control District, and the California Division of Highways.

The project is on U. S. 99. The dedication, which was held near to the junction of the state highway and San Fernando Boulevard, marked the end of four years of planning and construction to provide means to reroute heavy traffic away from the city's business area.

Plans for extending the truck highway from its southerly end at Providencia on through Glendale and thence directly into the City of Los Angeles are being discussed by state and local highway engineers.

In his dedicatory talk, Mayor Floyd J. Jolley of Burbank expressed appreciation of the cooperation between the governmental agencies involved in the building of the new highway. Both Highway Commissioner Harrison R. Baker of Pasadena and Spencer V. Cortelyou, former Assistant State Highway Engineer in Los Angeles, spoke in a similar vein.

"I want to make public acknowledgment of their part in this project to four representatives of District VII of the State Division of Highways: Paul O. Harding, Assistant State Highway Engineer; William L. Fahey, District Engineer; Mark E. Cessna, District Engineer; and E. S. Gripper (retired), Engineer in Charge of City Projects; also to E. A. Burt, Chief Deputy, Los Angeles County Road Commissioner; M. E. Salsbury, Senior Assistant Chief Engineer, Los Angeles County Flood Control District."

Mayor Jolley introduced the following: Joseph Mellen, Planning Director of Glendale; Robert W. Omer from the Burbank Chamber of Commerce; Harvey Ling, publisher of the *Burbank Daily Review*; James Lintner, publisher of the *Burbank News*; Niver Beaman, editor and general manager of the *Burbank Daily Review*; James Lapsley, former councilman of Burbank; Al Rediger, Horace Thompson, and Miss Adelyn Banks, editor of the *Burbank News*.

Among Burbank city officials who attended the dedication were:

Vice Mayor Ralph Hilton and councilmen Walter Hinton, Walter Mansfield and Paul Brown; City Manager Howard L. Stites, Assistant City Manager Edgar J. Friedrich, City Engineer Clayton Paige, Engineer William Bar-

Looking northwesterly from the vicinity of Burbank Boulevard. Note paved channel in right foreground

New alignment looking southeasterly from the junction with San Fernando Boulevard

rett, General Manager of Public Service Department James McCambridge, City Attorney Archie Walters, Planning and Transportation Engineer Harmon Bennett, and Administrative Assistant Public Relations E. Clifford Hill.

At 11.30 a.m., Mayor Jolley, Commissioner Baker, and a traffic officer flagged down the truck driven by Claude Barnes of Glendale and congratulated him upon being the first driver to officially use Burbank's new two-mile highway.

The new route is expected to save truckers 15 minutes in passing through Burbank as well as alleviate congested traffic conditions in the business district of Burbank.

Started in 1945, the highway was constructed in three units. The first section extends from Providencia Avenue to Orange Grove Avenue; the second is between Orange Grove and Burbank Boulevard, and the third extends from Burbank Boulevard to Broadway.

Burbank Boulevard intersection looking northwesterly

No Small Job

Four Million Dollars Spent on Lakewood-Rosemead Project

By P. O. HARDING, Assistant State Highway Engineer

When the California State Legislature, in 1933, took Route 168 into the State Highway System, the route as then established between Long Beach and Pasadena on the easterly outskirts of the Los Angeles Metropolitan area, followed along Lakewood and Rosemead Boulevards, existing county roads. These county roads contained many sharp angle jogs and were at various stages of development, generally being two-lane highways surfaced inadequately for the heavy volume of traffic to be handled.

The problem which the Division of Highways faced at that time was, as quickly as availability of construction funds permitted, to straighten the alignment and provide heavy duty type two-lane pavement throughout the entire 26.3 miles of this very important north and south traffic artery.

Surveys were started, plans prepared, and rights of way secured on portions of this route in the early part of 1934, and three construction contracts were completed during the year 1935 covering about 10 miles of new construction. During the years that have elapsed since this state highway route was taken into the system, a total of 24 construction contracts have been carried out, for which the total expenditure, including rights of way acquisition costs, has been over $4,000,000.

First Division Strip

It is interesting to note that this Lakewood-Rosemead highway project was one of the first traffic arteries for which the decision was made that traffic moving in opposing directions should be separated by a neutral area central dividing strip. The first type of central dividing strip to be placed on this project was carried out under a contract completed in September, 1937. This contract called for a four-foot wide neutral area central dividing strip for 3.5 miles of Lakewood Boulevard extending from Manchester Avenue southerly to Center Street.

The dividing strip on this project consisted of two standard double white traffic stripes, each nine inches in overall width, spaced four feet apart, with the area between containing raised arrows. The raised arrows were constructed of asphalt concrete, having a total width of three and one-half feet and an average thickness of approximately three-quarters inch. These arrows were spaced 10 feet apart on a diagonal, alternately pointing in opposite directions. The thought was that the arrow construction would assist in directing and separating traffic partly because of the appearance and partly by reason of the fact that the driver of any vehicle which passed over the double stripes and got into the central area would find driving over the raised arrows so bumpy and uncomfortable that he would get back into the proper lane as quickly as possible. The cost of the arrows placed under this first contract was 70 cents each, and the arrows served well for several years. In fact, raised arrows of this same type are still in use on sections of the Lakewood-Rosemead project north of Valley Boulevard.

Curbed Dividing Strip

It was later determined that a more definite and positive type of central dividing strip was required so that traffic moving in one direction would be prevented from conflicting with traffic moving in the opposite direction. Subsequent widening contracts were awarded for placing sections of curbed central dividing strip. Several miles of curbed central dividing strip were constructed, with the minimum width being four feet.

Recent contracts for improvement of the Lakewood-Rosemead project have been on the basis of constructing curbed central dividing strips from 16 to 30 feet in width. The wider central division strips have been placed at those locations where right of way widening to 120 feet and more could be carried out without too great expense. In many locations, due to the built-up and developed conditions of the abutting property, it would have been very expensive to have attempted to widen the existing 100-foot width of right of way sufficiently so that wide central dividing strips could be installed. This is the reason that so much of the central dividing strip is only four feet wide.

Traffic Problem Relieved

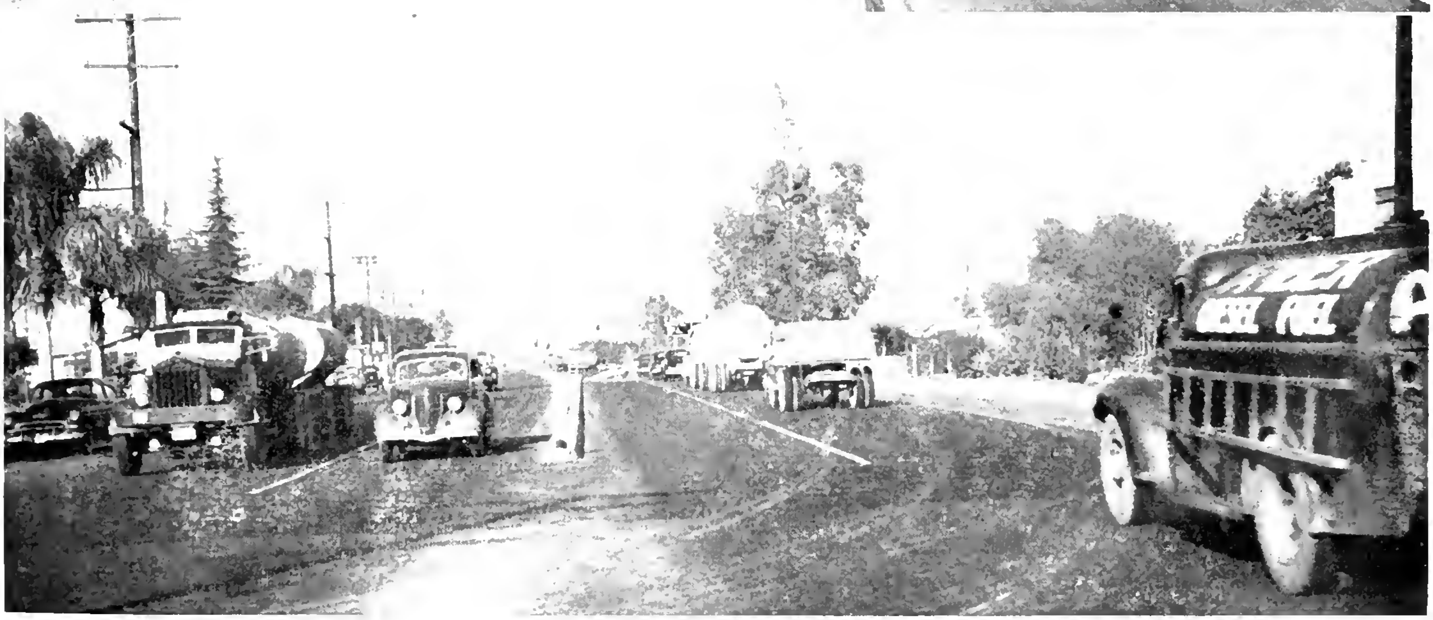
Completion on August 26, 1949, of the contract for widening and modernizing Rosemead Boulevard between Bellflower Boulevard and Beverly Boulevard relieved a very difficult traffic situation. This contract, which was 5.90 miles in length, costing $560,000, crossed State Highway Routes 174 (Firestone Boulevard), 166 (Anaheim-Telegraph Road), 2 (Whittier Boulevard), and Washington Boulevard, a Los Angeles County highway, all roads of heavy traffic density. Traffic using this section of Route 168 is of three types: (1) Through traffic originating in Pasadena with the beach areas as destination; (2) local traffic from the farming and industrial areas; (3) cross traffic and turning traffic from the rapidly expanding residential subdivision areas to the industrial areas and downtown Los Angeles.

Pavement Widened

The existing pavement, which was generally 30 feet in width accommodating three lanes of traffic, was widened to provide two 32-foot roadways, with opposing traffic separated by a 16-foot wide curbed dividing strip and bounded by outer curbs. The outer curbs and three-foot gutters were inte-

→

UPPER—Looking northerly across Beverly Boulevard intersection. CENTER—Looking northerly from vicinity of Anaheim-Telegraph Road, showing portion of Rosemead Boulevard recently completed. BOTTOM—Looking northerly across Olympic Boulevard toward Beverly Boulevard



gral and constructed of Portland cement concrete. The original ground between outer curbs and existing pavement was graded to a variable depth below finished grade determined by the basement soil values as necessary to provide needed cover. The trench was then backfilled with a corresponding variable depth of imported subbase material, eight inches of untreated rock base, and surfaced with four inches of plant-mixed surfacing. The existing pavement between edge and center dividing curb was resurfaced with a minimum thickness of two inches of plant-mixed surfacing.

Crossovers Provided

The 16-foot division strip was curbed for the entire length of project, the curb being constructed of Portland cement concrete and superimposed upon the existing pavement. Crossovers were established at all through streets and at regular intervals between through streets. Storage lanes were provided for left turns at main intersections. The area within the division strip was filled earth over the existing pavement, and surfaced with plant-mixed surfacing and a seal coat for color differential.

A provision of the contract allowed public traffic to pass through the construction area at all times. Other conditions affecting construction operations were the relocation of the many utilities and a separate contract for the installation of traffic signals and highway lighting that was under way at the same time. In order to meet these conditions, construction operations and utility relocations were confined to half-width roadbed between intersections, the intersections in turn being constructed by half-width method after installation of traffic signals. This allowed public traffic the unrestricted use of half roadbed throughout the entire project, and full width use on completed sections immediately following each day's full-width paving. Vido Kovacevich and Company was the contractor. F. E. Sturgeon was the resident engineer for the Division of Highways.

Most Recent Contract

The most recent contract to be completed on Rosemead Boulevard was for widening the 4.3-mile section between Beverly Boulevard and Garvey Avenue. By completing the grading and paving of this $510,000 contract about two and a half months ahead of schedule, the contractor, J. E. Haddock, Ltd., was able by careful planning and added effort to provide the 1950 New Year holiday traffic with another section of four-lane divided highway on Rosemead Boulevard. Several cities, located to the south of Beverly Boulevard, that had entered huge floral floats in the New Year 1950 Tournament of Roses Parade in the City of Pasadena, routed these beautiful floats through the new divided highway without hazard or traffic congestion.

Prior to widening improvement this section of old 20 and 30-foot widths of pavement constructed in 1937 actually bulged with slow moving traffic and endless strings of trucks from the many rock and sand plants located in the San Gabriel River Basin.

Widening Improvement

With the recent widening improvement, southbound traffic now has the exclusive use of the original two-lane pavement since the new improvement, constructed to the east of the original pavement, provides for a curbed division strip 18 feet wide, and two 12-foot lanes of new Portland cement concrete pavement with an eight-foot shoulder for the northbound traffic. The curbed division strip, planted with flowering ice plant, provides frequent cross-over openings marked with the new standard reflectorized units.

The former stop signs at both Beverly Boulevard and San Gabriel Boulevard intersections are now supplemented with the new three-way traffic signals and illuminated with brilliant overhead lights.

At the location known as the Whittier Narrows, strata of bedrock check the flow of the underground drainage that flows southerly from the great fan-shaped area between the City of Pasadena and the City of Pomona. Owing to the rise of groundwater level north of the narrows, the grade of the new widened roadbed was designed and constructed from one to four feet higher than the existing pavement.

Soil Reports

From preliminary soil reports thick layers of peat moss and other unsuitable materials were located and removed to solid ground elevations during rough grading operations. Unsuitable materials were excavated to depths from five to eight feet below the natural ground surface. In these areas imported base material was used to backfill the extra depths and to construct the roadway embankment.

All new lanes of pavement were constructed with Portland cement concrete eight inches in thickness, over a base of cement treated subgrade four inches thick, and a variable thickness of imported base material. The large deficiency in roadway excavation quantities were made up with imported base material consisting of cohesionless sand from the near-by Rio Hondo streambed.

Traffic During Construction

Traffic was maintained through construction over the old existing highway, and through the Whittier Narrows line change, over a 24-foot width of the new pavement subgrade which was specially treated with road oil for the convenience of the traveling public. The intersections at Beverly Boulevard and at Garvey Avenue were reconstructed to the new grades and widths with varying thicknesses of asphaltic concrete.

Shortly after the highway construction work was started, many small factory buildings were constructed between San Gabriel Boulevard and Garvey Avenue. Until this time the property was classed as unimproved land with groundwater too close to the surface for building construction. At Fawcett Street intersection the corner property was purchased for a drive-in theater, and near Bruin Street intersection the Mobile House Construction Company has completed a house assembly plant from which finished houses are hauled away on dollies over Rosemead Boulevard and with little inconvenience to the traveling public, thanks to the new wide divided highway.

... Continued on page 53

East Shore Freeway

Rapid Progress Being Made On Alameda County Freeway

EVIDENCE of the early completion of another 3.3 mile unit of the East Shore Freeway in Alameda County is noticeable in the progress being made by Fredrickson & Watson Construction Company on its contract which covers that portion of the new route between 50th Avenue and the southerly city limits of Oakland.

Work began on this project during May, 1949, and is expected to be completed in the spring of 1950, permitting public use of this section of freeway approximately three months earlier than the estimated contract completion date of August, 1950.

The completion of this unit and the two major structure contracts now nearing completion between 38th and 50th avenues will make available approximately seven miles of full freeway through the heavy industrial area in Oakland between Oak Street and the south city limits.

A 3.8 mile southerly extension of this project has been financed and will be let to contract early in 1950 at a cost approximating $4,000,000 and will connect the freeway to the present road in the vicinity of San Lorenzo Village during 1951.

Well Planned Program

A well planned program of obstruction removal, utilities relocation and sub-soil consolidation, in advance of the actual construction project, contributed much to the smooth performance of the contractor's organization. Advance planning by the State protected the right of way through the Brookfield Village housing project at the southerly end of the contract, precluding costly moves that would have otherwise occurred.

Relocation of public utilities was started before bids were opened and this work was completed without conflict with the contractor's operations. The East Bay Municipal Utility District had also completed a section of 42-inch interceptor sewer paralleling Hegenberger Road prior to the road contractor's operations.

Under an earlier contract, dredger sand fill was pumped in from the bay and placed between 50th Avenue and Hegenberger Road, including a three- to five-foot overload which, in addition to accelerating consolidation of

East Shore Freeway looking north, showing Hegenberger grade separation

East Shore Freeway looking north. High Street separation under construction in foreground

East Shore Freeway looking south. Forty-second Avenue interchange and High Street separation in foreground

underlying marsh land, furnished embankment material for a portion of this contract.

Built on New Alignment

The fact that this project is being built on entirely new alignment free from traffic except for two intersecting roads adds to the rapid progress being made. By the end of August, 1949, grading operations on the freeway section were practically completed and the placing of Portland cement concrete pavement began on September 1st and was completed by October 7th.

The project includes the construction of 3.3 miles of freeway, consisting of a four-lane divided highway, two major interchange structures, and the necessary approaches.

The freeway section consists of two 12-foot Portland cement concrete pavement lanes in each direction, with a 36-foot dividing strip. The design provides for an ultimate development of a six-lane divided highway, the additional lanes to be placed in the central dividing strip, leaving three lanes on each side, separated by a 12-foot division.

The Portland cement concrete pavement, eight inches in thickness, was placed on dredger sand embankment of which the top three inches was stabilized with liquid asphalt.

Outer Highway Provided

On the approach roads and ramps the pavement consists of varying widths of plant-mixed surfacing placed on subgrade of from six to eight inches of crusher run base on a minimum of one foot of dredger sand. An outer highway is provided along the westerly side of the project between High Street and Hegenberger Road.

As this section of the East Shore Freeway separates the East Oakland residential district from the heavy industrial area and the Oakland Airport, two interchange structures are being constructed under this contract.

The 98th Avenue Interchange Structure, costing approximately $110,000, is a six-span steel girder bridge with a 26-foot concrete roadway and two five-foot sidewalks and provides connection to the present route over 98th Avenue.

HIGHWAY RESEARCH BOARD AWARD

Word has just been received from Roy W. Crum, Director of the Highway Research Board, Washington, D. C., that F. N. Hveem and R. M. Carmany of the Materials and Research Department of the Division of Highways have been awarded the Highway Research Board Award for the outstanding paper for 1948, for their paper discussing, "The Factors Underlying the Rational Design of Pavements." This paper was presented at the Twenty-eighth Annual Meeting of the Highway Research Board, December, 1948.

The Highway Research Board Award was instituted in 1940 for the purpose of giving recognition to the author or authors of papers of outstanding merit presented at the annual meetings of the board.

The currenr award of the Highway Research Board represents the third national award to members of the staff of the Materials and Research Department for reports on important research conducted by the department; the two previous awards being the American Concrete Institute award of the Wason Medal in 1938 and the American Society of Civil Engineers Award of the Norman Medal in 1943.

The four-lane Hegenberger Interchange Structure, costing about $315,000, is a major link in the new freeway system. Crossing over the freeway at a skew of 50 degrees, this structure will carry all traffic from the Oakland Airport desiring to use the freeway as well as other local and cross traffic.

This structure consists of two bridges, using common footings, abutments and dividing strip. Each contains 10 spans with five girders per span and a five-foot sidewalk over the outside girder. Each roadway is 26 feet wide, separated by a six-foot dividing strip.

Uniform Concrete Surface

All formwork for exposed surfaces was faced with plywood to minimize finishing and was so designed as to eliminate form bolts from passing through the concrete whenever possible. This resulted in a uniform appearing concrete surface showing the grain of the plywood thereon. All the columns and caps for each bent at Hegenberger Road were formed as a unit, giving continuous straight lines and the appearance of a single column when viewed from the ends.

The 98th Avenue overcrossing was opened to cross traffic on November 25th; the south half of the Hegenberger overcrossing was opened to cross traffic on December 9th and the north half on December 22d.

The estimated final cost of work to be done under this contract is $1,412,000.

Rapid Progress

During the month of September 21st to October 20th the value of work performed under this contract, and which included the furnishing and erection of all the steel girders on both overcrossings, and approximately half the concrete pavement, amounted to $400,376, indicating the rapid progress being made.

Following are the approximate quantities of major items of work on this project:

Roadway excavation	262,000 cubic yards
Structure excavation	7,500 cubic yards
Overhaul	9,200,000 station yards
Imported base material	71,900 tons
Applying water	11,750 M. gallons
Crusher run base	20,100 tons
Plant-mixed surfacing	9,100 tons
Portland cement concrete (pavement)	21,500 cubic yards
Bar reinforcing steel	564,000 lbs.
Structural steel	1,984,000 lbs.

The work is being done under the direction of Assistant State Highway Engineer Jno. H. Skeggs, with G. L. Beckwith as resident engineer and Milt Schwartz as Bridge Department representative. Fredrickson & Watson Construction Company of Oakland are the contractors, with Karl Poss as general superintendent.

Progress Report

Hollywood Freeway Structure Rapidly Nearing Completion

By J. M. PETERSON, Associate Bridge Engineer, and H. ROSS CLINTON, Assistant Steel Inspector

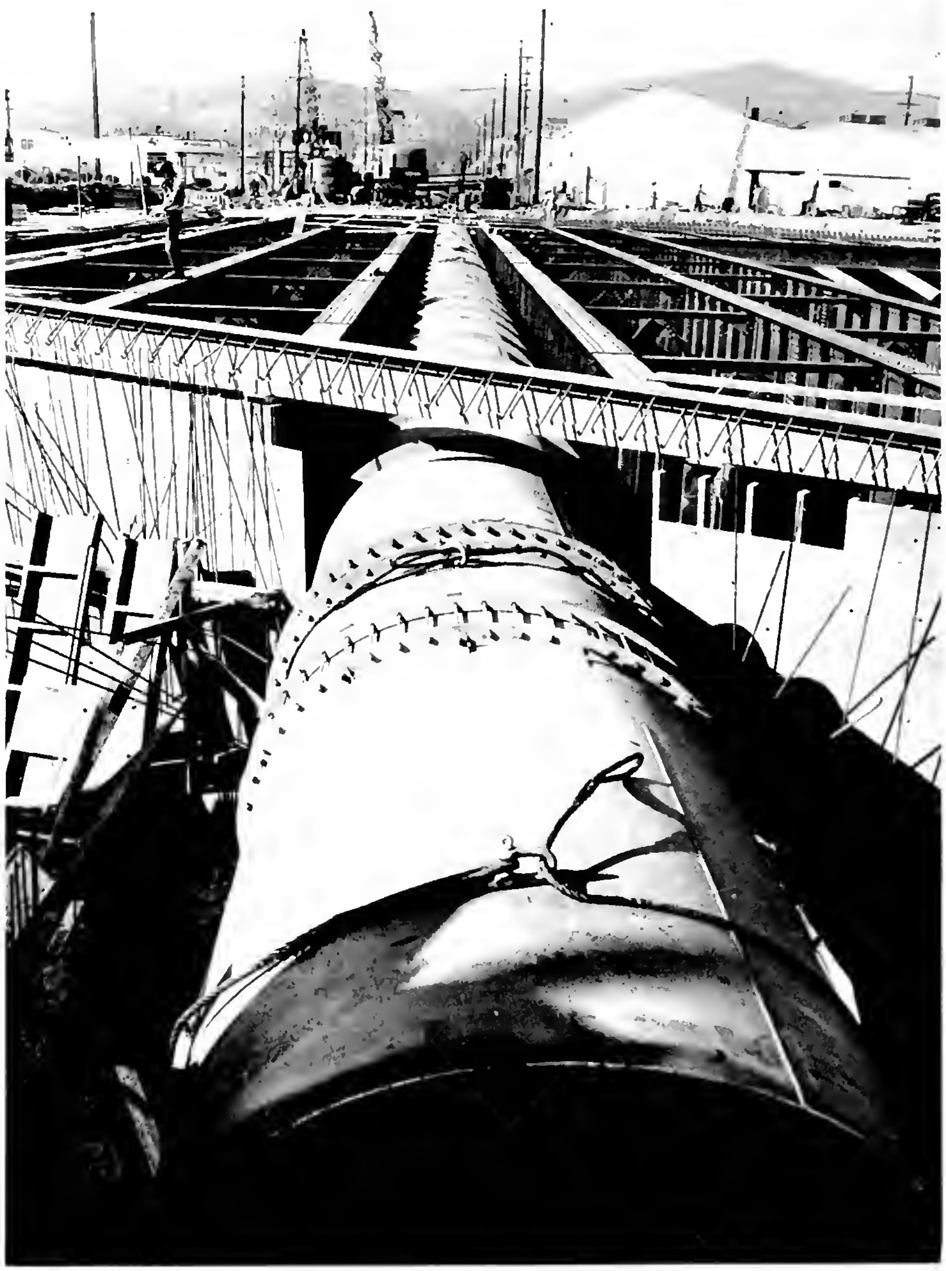
THE WESTERN AVENUE overcrossing on the Hollywood Freeway now nearing completion is one of the many structures under contract in the Los Angeles area, which are being constructed as a portion of the system of freeways to relieve the vehicular congestion in the Greater Los Angeles area.

This overcrossing will carry the heavy north-south bound truck and vehicle traffic on Western Avenue over the Hollywood Freeway, a few blocks north of Santa Monica Boulevard. Inasmuch as this project is in the heavily populated section of Los Angeles, a great many public utilities, sewers, and storm drains were encountered and had to be provided for in conjunction with the remainder of the work.

The problem of detouring a large volume of vehicular and pedestrian traffic around the construction site was also of major concern. In the face of these obstacles, the cooperation of the city, State, and the various public utility companies was a vital force in the smooth completion of the project.

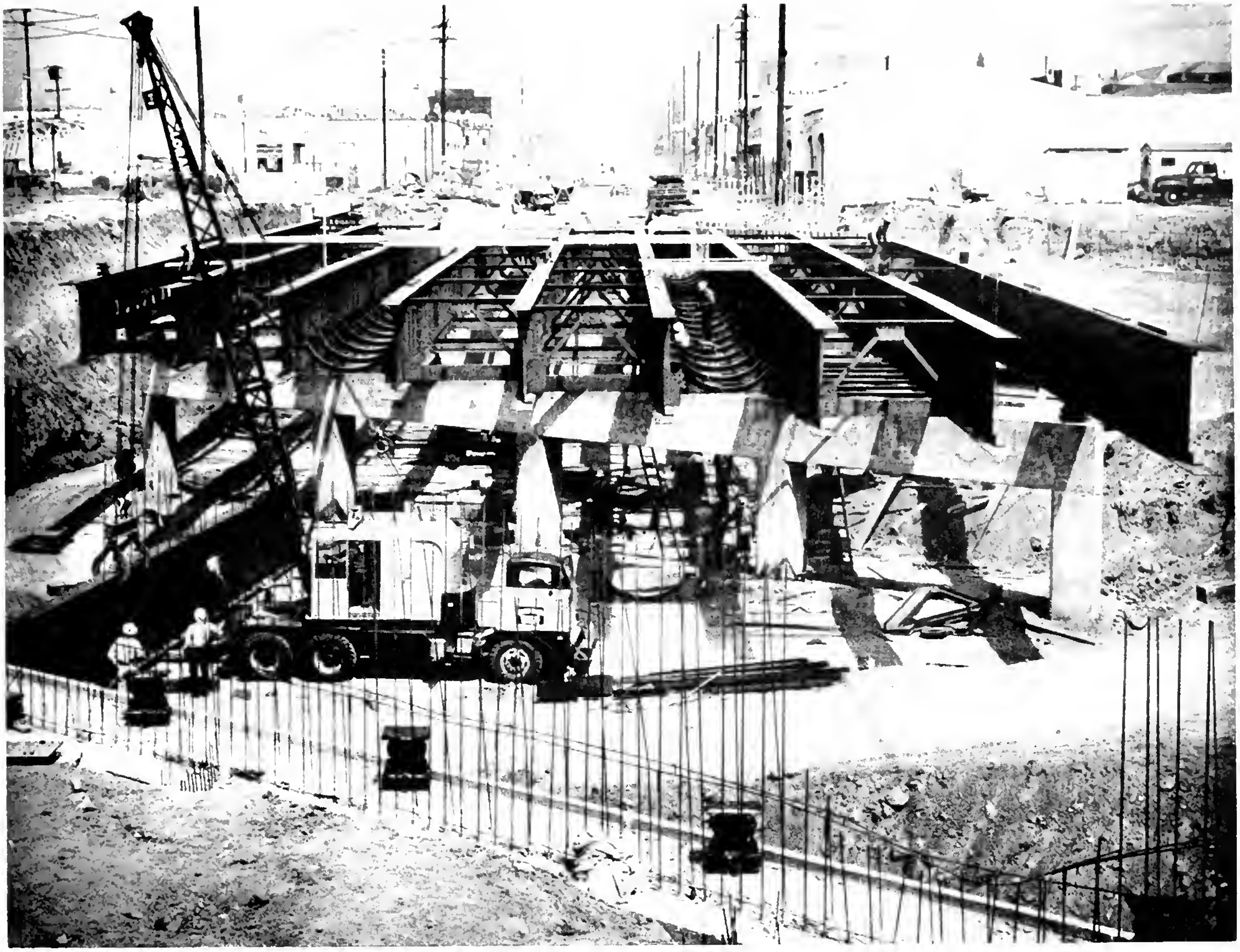
Only Steel Structure Erected

This overcrossing at Western Avenue is the only steel structure erected so far on the Hollywood Freeway. The limited difference in elevation between the Hollywood Freeway and the grade of Western Avenue required a superstructure which would have main supporting members of the shallowest feasible depth. To meet this limitation they were designed as riveted steel plate girders approximately seven feet deep.



East storm drain looking north through bridge on Western Avenue

A contributing factor in the selection of the steel girder design was the necessity of the structure carrying two large pipes to accommodate the Western Avenue storm drain system. The large cross-sectional area of these drains coupled with the shallow depth of the girders made it necessary to carry the storm drains in elliptical welded steel pipes 5 feet 6 inches high and 6 feet 11 inches wide. These pipes in themselves were one of the interesting problems in the construction. They were carried across the



Photograph showing construction on Western Avenue overcrossing on Hollywood Freeway

structure on cradles framed between the bridge girders. The cradles themselves acted as diaphragms between the members.

Two Spans Over Freeway

The new structure provides two spans of 118 feet each over the lanes of the Hollywood Freeway and in conjunction, bus ramps and stairways up to the Western Avenue level. The Western Avenue traffic across the freeway is carried on a 60-foot roadway with a 10-foot sidewalk on each side. The structure is unsymmetrical in that La Mirada Avenue is carried westerly on to the bridge on a wing which extends out over the northeast wingwalls. There are no "On" or "Off" ramps to the Hollywood Freeway provided at Western Avenue. However, ramps will eventually be constructed at short distances on either side of this location.

The steel work was fabricated in Los Angeles and was notable for the very high quality of the work—which contributed much to the ease with which the structure was assembled. All holes were subpunched and reamed out to full size, after which shop rivets were driven with a 100-ton hydraulic riveting machine.

Steel Girders

The steel girders were erected in three pieces, using temporary steel falsework bents. The north third of each girder was erected, followed by the middle and then the south portions which were joined by splices.

The elliptical pipes, after being sandblasted and coated with coat tar enamel, were erected in 30-foot sections and subsequently welded. After erection the assembled pipes were tested for leakage.

Another interesting feature of the construction was the necessity for providing a shoofly ditch to take care of the flow in the storm drains on Western Avenue. This was handled by constructing a large V-shaped channel around the construction work. The channel, approximately eight feet deep and 500 feet long was given a gunite

. . . Continued on page 55

Prison Labor

Story of Highway Road Camps In the State of California

By G. A. TILTON, JR., Supervising Highway Engineer

This is the sixth article in a series appearing in *California Highways and Public Works,* recording the history, legislation and administration of State Highway Prison Road Camps in California since the first camp was established in September, 1915. The five previous articles include:

(1) History and Legislation .... March-April issue
(2) Organization .... May-June issue
(3) Camp Layouts .... July-August issue
(4) Feeding and Nutritional Accounting .... September-October issue
(5) Custody, Care and Welfare .... November-December issue

Two distinct accounting requisites are involved in Prison Road Camps administration, (a) accounting of construction funds and (b) accounting of wages paid to inmates. This article covers accounting of wages paid to inmates.

SINCE THE INAUGURATION of California's prison road camp pay-system in 1923 * legislative controls have provided that the Department of Public Works administer and account for inmate wages and act as trustee of individual inmate net earnings during the inmate's camp tenure.

With camps located in widely separated and remote areas of the State it was obvious at the time the pay-system was enacted into legislation, that the road camps would require accurate accounting and rigid control of inmate funds. Accordingly, original legislation was drawn up to include specific accounting requirements that have needed comparatively little revision.

Road Camp Accounting

The following excerpt from statutes governing prison road camps provides the basis for accounting of inmate funds.

Penal Code Section 2762: "* * * Said department (Department of Public Works) shall set up an account for each convict which shall be credited monthly with an amount computed by multiplying the daily rate by the number of days such convict actually performed labor during the month. Such account shall be debited monthly with the convict's proportionate share of all expenses of camp maintenance, including the expenses for food, medicine, medical attendance, clerical and accounting personnel, and the expenses necessary to maintain care and welfare facilities such as camp hospital for first aid, barber shop and cobbler shop, and the convict's personal expenses covering his drawings from the commissary for clothing, toilet articles, tobacco, candy and other personal items. The charge for camp maintenance may be made at a standard rate determined by the department to be adequate to cover all expenses and shall be adjusted periodically at the discretion of the department as needs of the camp require."

Camp Operational Accounting

Revenue for inmate camp funds is derived from wages paid to inmates for labor performed on construction projects which is deposited to the account of the "Inmate Camp Fund." †

General ledger accounts are maintained for the following functions of camp operation:

ASSET ACCOUNTS	
Cash Account	
Inmate Camp Fund	Camp operation
Inmate Personal Fund	Inmate net savings held in trust by the Division of Highways
Accounts Receivable	Revenue and income on sale of meals to free employees
Inventory Accounts	
Stores	All camp functioning material and supplies, including minor equipment and excluding supplies for the personal use of inmates
Commissary	Merchandise for sale to and personal use of camp inmates, bedding, seasonal clothing, hospital and barber supplies
Major Camp Equipment	All major equipment for camp operation, including kitchen equipment, tables, chairs, beds, stoves, etc.
Operating Accounts	
Board	Food supplies, fuel and refrigeration, depreciation—kitchen equipment, inmate labor
General Camp Expenses	Supplies, depreciation—camp maintenance equipment, labor camp maintenance
Care and Welfare	Medicine, supplies—barber, cobbler, etc., inmate labor
Administration	Salaries—commissary clerks, salaries—headquarters accountants, supplies—miscellaneous
LIABILITY ACCOUNTS	
Accounts Payable	Disbursements
CONTINGENCY RESERVES	
Contingency Reserves	Reserve account for contingent expense

* *From 1915 to 1923 the camps were operated with generally unsatisfactory results under a nonpay system.*

† *The wage paid to inmates at the present writing is $3.30 for each day work is performed on construction—average 26 days per month.*

. L. A. McCandless (1928-1942); 2. H. L. Waste (1930-1945); 3. H. D. Johnson (1947 to date); 4. W. B. Stout (1929 to date); 5. H. L. Leventon (1928-1937); 6. A. N. Lund 1922-1931); 7. B. H. Henry (1930-1947); B. R. C. McFarland (1930 to date); 9. G. D. Grant (1921-1925); 10. H. F. Catan (1947 to date); 11. Ed Rawson (1919-1947); 12. W. B. Albertsan (1915-1947); 13. R. W. Brown (in foreground) (1918-1926)

Disbursements, audit of camp reports, bank accounts of the "Inmate Camp Fund" and "Inmate Personal Fund," general ledger accounts, and subsidiary ledger of inmate accounts are maintained and controlled by the Headquarters Accounting Office, which also maintains detailed costs and statistical records for managerial control and administrative study.

Camps Self-supporting

It is the intent of legislation and a prerequisite of administration that the camps be self-supporting. To accomplish this objective they must be so managed that the expense of maintenance shall not exceed income from inmate wages and at the same time provide a small daily net savings for the inmates.

Account Set-up for Each Inmate

As required by statute, an account is set up for each inmate. His wages are credited to his account and the pro rata expense of maintaining the camp is deducted therefrom, including feeding, housing, clothing, care and welfare, administration, and his purchases from the commissary, such as tobacco, candy and toilet articles—the balance is the inmates' net earnings.

Contingency Reserve

Statutes provide that the Department of Public Works, in computing the debits to be made to the inmates' accounts, may add an amount, not to exceed 10 percent on all items, as a reserve for contingent expenses such as medical and hospital expense * where an inmate is injured while engaged in occupational duties, temporary operational losses, commissary adjustments and miscellaneous contingencies. At present a contingency reserve charge of 1 cent per day against the account of each inmate has proven sufficient to cover such expense.

Camp Records and Reports Handled by Commissary Clerk in Camp

Requisitions for supplies, reports of camp operation, and records of inmates originate in each camp under the direction of the commissary clerk and camp superintendent and are forwarded to headquarters for processing.

* *Medical expense for injuries or sickness not due to occupational duties is charged to the inmate's individual account.*

All camp equipment and supplies are purchased from vendors by purchase order authorization through the California Department of Finance Purchasing Division, based upon bid proposals.

Reports of camp operations and records of inmates include the following:

a. Inmate gross pay rolls
b. Inmate net pay rolls
c. Stores inventory
d. Commissary inventory
e. Equipment inventory (quarterly)
f. Population
g. Cost report
h. Expenditure register
i. Journal summary
j. Final statement of inmate earnings

Audits and Inventories

All camp records and inventories are audited at regular intervals by district and headquarters personnel. Similarly, camp stores and commissary stock are inspected and inventoried jointly by district and headquarters accountants at irregular intervals.

Accounting of Inmate Net Earnings

The balance of an inmate's monthly wages remaining after pro rata deductions for camp maintenance and deductions for commissary drawings, is his net earnings, or savings, for the month. This is credited to his personal account † or, if the deductions are greater than his earnings for the month, his account is accordingly debited.

The inmate's net earnings or savings are transferred from the Inmate Camp Fund and deposited to the account of the Inmate Personal Fund and held in trust for the inmate until he leaves camp. Disbursements are made from the inmate's personal account only under the following conditions:

a. When any inmate is returned to the institution for any reason, his entire credit balance is transferred to the institution.

b. Compulsory payments to dependents not to exceed two-thirds of the inmate's net credits, when dependents are receiving state aid.

† *Present average net earnings approximate \$0.50 per day—some inmates net less than \$0.50 depending on the number of days worked and amount of their personal commissary drawings. Others net the \$0.75 per day maximum permitted under law.*

c. Voluntary payments to legal dependents, not receiving state aid when requested by the inmate, not to exceed two-thirds of the inmate's net credits.

Compulsory Allotments to Dependents Receiving State Aid

Whenever an inmate's dependents are receiving state aid during his tenancy in camp, the Division of Highways is required by statute to pay to his legal dependents monthly, an amount from his net credits that the department estimates will equal, but will not exceed, two-thirds of his total net credits during the period of employment, excepting that no payment shall be made to dependents which will reduce the inmate's credit balance below \$25.

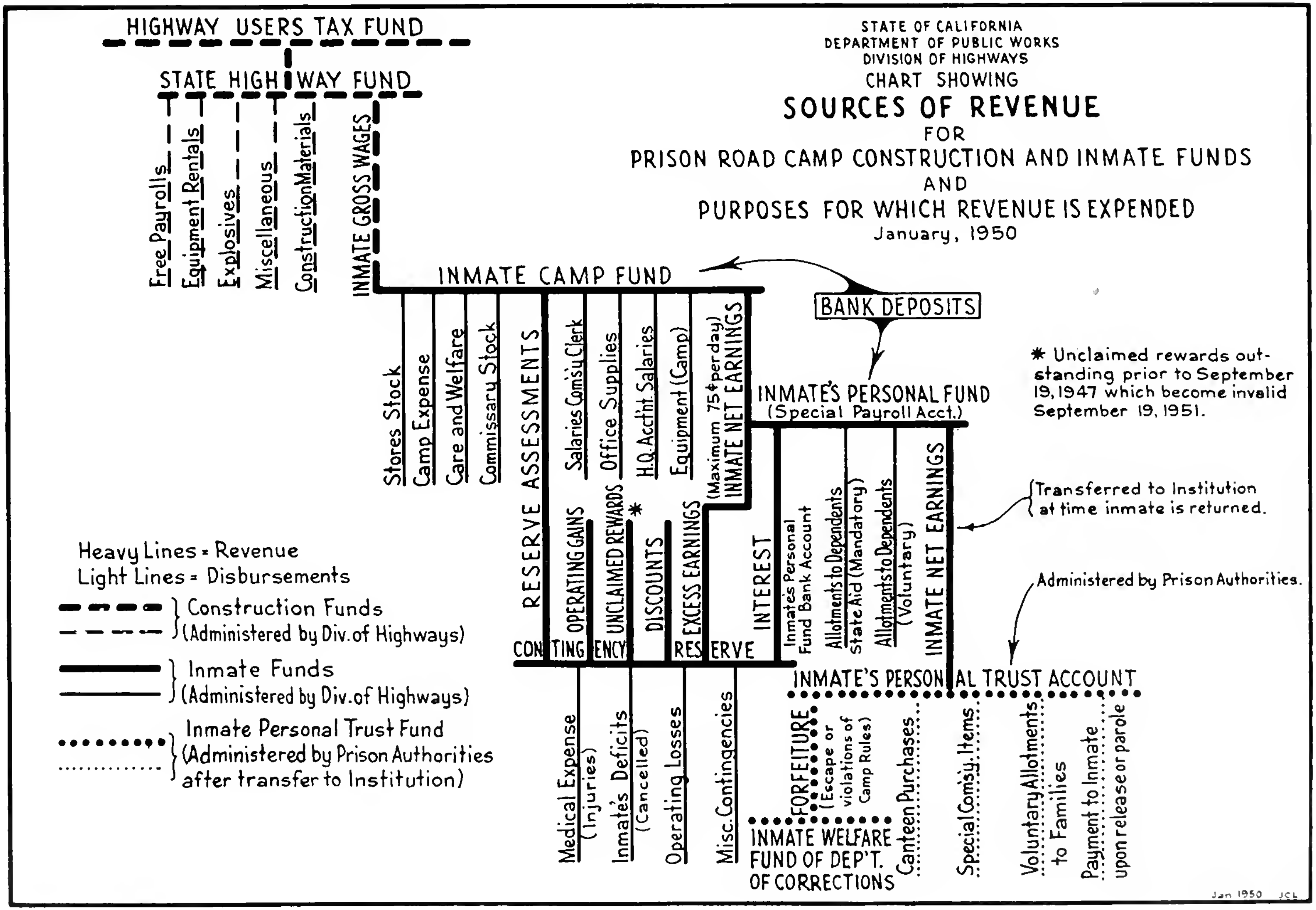
Allotments to dependents in state aid cases are initiated upon advice from county welfare departments that an inmate's family is a state aid case.

Voluntary Allotments to Dependents

If an inmate's dependents are not receiving state aid, he may, upon written order request the department to make payments to persons legally dependent upon him for support. Voluntary allotments are subject to the same minimum balance requirements as compulsory allotments. All requests for voluntary allotments are investigated before approval to determine the validity of the case with a view to conserving the inmate's earnings for the time when he most needs it—upon release to society.

Statutes Controlling Allotments to Dependents

Penal Code, Section 2763: "The Department of Public Works shall monthly pay from the net credit to each convict's account to his dependents who are receiving state aid such amounts as the department estimates will equal but will not exceed two-thirds of his total credits during the period of his employment. Immediately prior to or upon the termination of the employment hereunder of any convict for any reason, any additional payment necessary to such dependents to cause the total amount paid to them to equal two-thirds of the convict's net credits shall be made. If the convict's dependents are not receiving state aid, such convict by written order signed by him, may direct the department to likewise make such payments in the same manner to such dependents as he designates. In no event,


STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
CHART SHOWING
SOURCES OF REVENUE
FOR
PRISON ROAD CAMP CONSTRUCTION AND INMATE FUNDS
AND
PURPOSES FOR WHICH REVENUE IS EXPENDED
January, 1950
HIGHWAY USERS TAX FUND
STATE HIGHWAY FUND
Free Payrolls
Equipment Rentals
Explosives
Miscellaneous
ConstructionMaterials
INMATE GROSS WAGES
INMATE CAMP FUND
Stores Stock
Camp Expense
Care and Welfare
Commissary Stock
RESERVE ASSESSMENTS
Salaries Com'sy Clerk
Office Supplies
H.Q. Acct'nt. Salaries
Equipment (Camp)
(Maximum 75¢ per day)
INMATE NET EARNINGS
BANK DEPOSITS
INMATE'S PERSONAL FUND
(Special Payroll Acct.)
✱ Unclaimed rewards outstanding prior to September 19, 1947 which become invalid September 19, 1951.
OPERATING GAINS
UNCLAIMED REWARDS ✱
DISCOUNTS
EXCESS EARNINGS
CONTINGENCY
RESERVE
INTEREST
Inmates Personal Fund Bank Account
Allotments to Dependents
State Aid (Mandatory)
Allotments to Dependents
(Voluntary)
INMATE NET EARNINGS
Transferred to Institution at time inmate is returned.
Administered by Prison Authorities.
INMATE'S PERSONAL TRUST ACCOUNT
Medical Expense
(Injuries)
Inmate's Deficits
(Cancelled)
Operating Losses
Misc. Contingencies
FORFEITURE
(Escape or violations of Camp Rules)
INMATE WELFARE FUND OF DEP'T. OF CORRECTIONS
Canteen Purchases
Special Com'sy. Items
Voluntary Allotments to Families
Payment to Inmate upon release or parole
Heavy Lines = Revenue
Light Lines = Disbursements
Construction Funds
(Administered by Div. of Highways)
Inmate Funds
(Administered by Div. of Highways)
Inmate Personal Trust Fund
(Administered by Prison Authorities after transfer to Institution)
Jan 1950 JCL

COMMENTARY ON SOUNDNESS OF HONOR-CAMP SYSTEM

The following incident of spontaneous inmate behavior under aggravating conditions, and subsequent group self-control, is cited as an excellent commentary on the soundness of the honor-camp system.*

On Sunday, March 12, 1939, a potentially serious hunger strike was reported in one of the Southern California road camps, resulting in an emergency trip to the camp by Warden Court Smith of San Quentin Prison, Dr. Leo L. Stanley, Chief Surgeon of San Quentin Prison, and the author representing the Division of Highways.

Upon arrival in the road camp it was learned that the camp was temporarily under control pending arrival of the warden and party. Investigation revealed the following chain of events:

During the absence of the regular camp sergeant on vacation, a relief guard was placed in temporary charge of the inmates, whom, it later developed, when given authority, tended to display an unfair and officious attitude towards the inmates, building up to a climax on the Sunday morning in question.

Two colored inmates, it was found, arrived at the mess hall door a few minutes late for breakfast. The temporary guard brusquely refused to let them enter the mess hall because they were late and did not take their hats off in time to suit him. This action on the part of the guard so incensed the other 120 inmates at breakfast that they rose en masse and left the mess hall in protest and returned to their cabins without finishing the meal. At noon the inmates likewise refused to eat lunch.

The camp superintendent, who was away from the camp at his home on Sunday, 30 miles away, was summoned to the camp, whereupon the inmates promptly and voluntarily lined up in front of their eight-man cabins and cited their grievances to him.

Upon the superintendent's statement that Warden Court Smith, Dr. Stanley and the author were on the way to the camp to investigate and correct the situation, the inmates were persuaded to eat their Sunday dinner and return to work the following day, thus avoiding what otherwise might have developed serious consequences.

The orderly manner in which the inmates conducted themselves under the circumstances and the camp superintendent's prompt and proper action is outstanding in the opinion of the author, in demonstrating the efficacy of the honor-camp system.

Guard conditions were quickly corrected by the warden and the camp continued with normal routine operations without further disturbance.

* *Documented by Dr. Leo L. Stanley, March 20, 1939.*

however, shall payments be made to dependents until there is a net credit to the convict's account of at least twenty-five dollars ($25), and no payment shall be made to dependents which will reduce said net credit below the sum of twenty-five dollars ($25). Dependents, as used herein, shall include only such persons who are legally dependent upon the prisoner for support."

Inmate's Personal Trust Account

When the inmate leaves the road camp for any reason, net earnings that have accumulated to his credit in the camp are transferred to the institution to which he is returned and deposited in the "Inmates' Personal Trust Fund Account." This trust fund is disbursed under jurisdiction of prison authorities for any of the following reasons:

a. Forfeiture of all or part of earnings for violation of camp rules;

b. Canteen purchases at the institution;

c. Voluntary allotments to families;

d. Special commissary items;

e. Payment to inmate upon release or parole.

Inmates Not Covered by Compensation Insurance

Inmates working in the camps are not entitled to any of the benefits of the Workmen's Compensation Insurance and Safety Act of 1917 as indicated in the following penal code section.

Penal Code, Section 2766: "* * * No prisoner so used on the state highway or roads shall be considered as an employee or to be employed by the State Highway Commission, nor shall any such prisoner come within any of the provisions of the Workmen's Compensation, Insurance and Safety Act of 1917 or be entitled to any benefits thereunder whether on behalf of himself or that of any other person."

Daily Wage Limited by Statute

The wage paid to inmates is limited by statute to a maximum of $3.50 per day and the inmates' net earnings are limited to a maximum of $0.75 per day—any amount exceeding $0.75 per day is credited to the Inmate Camp Fund Contingency Reserve Account.

The daily wage of inmates is adjusted periodically by the Division of Highways to meet changing conditions so as to keep the average net earnings within the above maximum $0.75 per day limitation insofar as possible.

For the 19-year period from August 17, 1923, to June 30, 1942, inmates were paid $2.10 per day under a statute limitation of $2.50 per day. From July 1, 1942, to date the maximum limitation and wage paid to inmates has been progressively raised by the legislature to $3.50 per day and likewise the actual wage paid has been progressively raised to $3.30 per day.

Strict Accounting and Auditing Warranted

Strict accounting and auditing of inmate funds has proved successful over the years in safeguarding the integrity of the road camp pay-system. Detailed accounting has been found to be essential from an administrative point of view, particularly since it is necessary to maintain financial solvency in the face of the narrow margin permitted between the inmate's gross wages and cost of camp maintenance.

The seventh and concluding article in this series, covering highway construction by inmate labor, will appear in the next issue of the California Highways and Public Works—EDITOR

Freeway Unit

New 4-Lane Divided Section Is Added to Coast Highway

By GEORGE T. McCOY, JR., Resident Engineer

Another unit of the program contemplated to develop the Coast Highway, U. S. 101, into a freeway from Los Angeles to San Francisco is added by construction of a four-lane divided limited access freeway in Santa Barbara County between Arroyo Quemado and Arroyo Hondo, a distance of two and six-tenths miles.

The narrow roadway width of the Arroyo Quemado and Arroyo Hondo bridges, which were constructed in 1917 and 1918, together with restricted sight distances afforded by alignment and grades on the approaches, presented a marked hazard to two-way traffic and were points of accident concentration.

The Arroyos of Quemado and Hondo do not require complete bridging to adequately provide for drainage so a design was adopted to place reinforced concrete arch culverts for drainage and construct embankments in lieu of bridges.

New lanes constructed for north-bound traffic on left. Existing roadbed serving south-bound traffic on right. Pacific Ocean in background

Wide Division Strips

The division strip between the northbound traffic lanes and the existing highway which is being utilized for the southbound traffic lanes is variable with a minimum width of 40 feet, 172 feet in width at Arroyo Quemado and 214 feet in width at Arroyo Hondo. These widths of division strip at the arroyos are required for the high embankments and for future construction to clear the Southern Pacific Company's right of way at such time as it becomes necessary to replace the existing bridges.

Because of the proximity of these 80- to 90-foot embankments to the existing highway bridges and the railroad facilities immediately downstream from them, it was essential that the stability of the embankment areas be carefully scrutinized.

Hand and Power Borings

Hand and power borings made throughout the embankment area in Arroyo Quemado indicated it to be a terrigenous deposit of silty sand, sandy clay, and silty clay with small to large fragments of soft sandstone of from 16 to 30 feet in depth, over bedded sandstones and shales. Soft plastic clay in the deposit had a moisture content of as high as 50 percent. Stability analyses indicated that the foundation soil would not safely support the fill without provision to reduce subsidence after construction by accelerating consolidation of the unstable foundation soil during placement of the embankment.

Prevalence of sandstone boulders in the heterogenous deposit of unconsolidated material made it impracticable to install vertical sand drains in the embankment area by either cutting or augering out, or by jetting a casing down to the underlying firm strata. Construction of the holes by driving mandrels or churn drilling was not considered advisable because of the possible effect of impact and vibration. A system of drainage trenches was therefore constructed in the embankment area.

Drainage Trenches

This system consists of a transverse trench and six lateral trenches. These trenches were excavated with a four-foot bottom width and as steep side slopes as the material would stand on to the underlying firm bedded sandstone and shale, and backfilled with beach sand. A transverse trench was also excavated and backfilled with beach sand to provide an adequate foundation for the reinforced concrete arch culvert.

Borings revealed that in the Arroyo Hondo embankment area the loose alluvium was from 5 to 10 feet in depth, underlain by a strata of compact sand and gravel over a bedded shale formation. The compact gravel formation has good supporting power and any shear failure within it is very improbable, and the bedded shale has sufficient strength to prevent displacement or shear failure, making the possibility of embankment instability at this location, which would affect adjacent structures, remote.

Egress for Water

A layer of beach sand was placed over the original ground in this embankment area to provide ready egress for water extruded from the surface layer of alluvium as it was compressed by placement of the embankment. The loose material in the foundation area for the reinforced concrete culvert was excavated to the compacted gravel formation and replaced with sand to prevent settlement of the structure.

Stability of both of these high embankments was increased by construction of support fills approximately 70 feet wide and about 25 feet in height along both sides of them. Settlement points and pore pressure gauges were installed for study of subsidence and control of embankment placement.

Basement Soils

Basement soils in general are of very poor quality, having California bearing ratios of from 2 percent to 6 percent and expansions up to 7.2 percent. A subbase consisting of 12 inches minimum thickness of beach sand was placed throughout most of the project. Surfacing on the new 24-foot width set of traffic lanes consists of a four-inch thickness of plant-mixed surfacing over an eight-inch thickness of base material. Imported borrow used for base material had a bearing ratio of 80 percent or more at one-tenth inch penetration on a compacted and soaked specimen, expansion of 0.5 percent or less, and a plasticity index of six or less. Shoulders and gutters are surfaced with a three-inch thickness of plant-mixed surfacing over an imported borrow base.

Principal construction items on the project consisted of 476,000 cubic yards of roadway excavation, 3,800 cubic yards of structure excavation, 14,600 cubic yards of ditch and channel excavation, 28,000 cubic yards of fill-treatment excavation, 73,000 tons of sand fill material, 2,700 cubic yards of Portland cement concrete (structures), 360,000 pounds of bar reinforcing steel, 37,000 tons of imported borrow, and 12,000 tons of plant-mixed surfacing. Total construction cost was \$680,000. Clyde W. Wood, Incorporated, of North Hollywood, California, was the contractor. The author was the Resident Engineer.

UPPER—View looking westerly across Arroyo Quemado. Existing narrow bridge on extreme left. CENTER—Fill constructed across Arroyo Quemado for new north-bound lane. Old bridge carrying south-bound traffic in background. Erosion of embankment slopes caused by rainfall of 7½ inches in twelve hours. LOWER—View showing embankment, existing highway bridge and railroad bridge across Arroyo Hondo

Ridge Route

Progress Made on Widening U. S. 99 to Four-Lane Limited Access Freeway

By W. L. FAHEY, District Engineer, District VII

ONE OF THE MOST IMPORTANT highway projects upon which the Division of Highways has embarked in recent years is the modernization of the Ridge Route between Los Angeles and Bakersfield. A progress report on this activity describing the widening that had been accomplished and the construction that was being carried out on the portion of the Ridge Route in District VII between the north city limits of Los Angeles and the Kern County line, was published in the July-August, 1949, issue of *California Highways and Public Works*. The author of this previous article was Spencer V. Cortelyou, and it was written while he was Assistant State Highway Engineer in charge of District VII. It will be recalled that Mr. Cortelyou retired from state service on October 1, 1949, and that his successor is Paul O. Harding. The purpose of this present article is to report concerning the current status of the modernization program on this route.

Lighter Grades

On December 8, 1949, a contract was completed covering the section of the Ridge Route extending from Los Alamos Creek to a point 2.3 miles southerly of Route 59. Progress on the conversion of the Ridge Route to a four-lane divided limited access freeway was advanced appreciably with the recent completion of this 6.7-mile section.

The grades on this particular section are lighter than on most other sections of the Ridge Route. The alignment also is better than average except for the first two miles at the southeasterly end of the contract.

In improving the alignment of these first two miles by increasing curve radii, the existing pavement, of necessity, was no longer useable and new pavement had to be laid on both the northbound and southbound roadways. Due to the restrictions of steep mountains on one side and the deep channel of Los Alamos Creek on the other, the central dividing strip through this section was limited to 18 feet in width between inner edges of the 24-foot pavement.

On the balance of the project the existing 30-foot concrete pavement was retained for use, and a new roadway was constructed for the traffic moving in the opposite direction. The median strip here is 36 feet in width.

Typical Section

The typical section called for four inches of plant-mix surfacing 24 feet wide, with eight-foot shoulders on the outside and five-foot shoulders on the inside. Three feet of the outer shoulder and two feet of the inner shoulder were paved with four inches of plant-mix surfacing. Eight inches of untreated rock base was placed over a variable thickness of imported subbase material.

While the actual construction followed the usual pattern, there were two items of particular interest, one being the source of subgrade materials and mineral aggregate, and the other being the contractor's speedy and efficient handling of job operations.

As mentioned in Mr. Cortelyou's article in the July-August, 1949, issue of *California Highways and Public Works*, the borrow-pit adjacent to the highway just north of Gorman Creek Bridge was purchased by the State for $750, or less than $20 per acre. The members of the District VII materials Department are to be particularly commended for discovering this source of material in a region seemingly devoid of any material suitable for subgrade and mineral aggregate. The granite

Looking northerly, showing in center background borrow pit for selected base material and mineral aggregate

This is another section of new highway looking northerly

found in the two knolls in this pit is not commonly found in this vicinity. The discovery was made by investigation of an outcropping at the location of a shift in the San Andreas fault which passes through this area.

Fine Grade Aggregates

This quarry site, located less than a quarter of a mile from the highway, produced not only subgrade material of exceptionally fine quality but also aggregate for plant-mixed surfacing equal to that from commercial plants in the Los Angeles area. The only possible objection to this material was its slight tendency to break up under compaction. This was anticipated by the materials department and overcome by setting up the grading specifications sufficiently coarse so that the final result would be within the allowable limits.

The contract for this work was awarded May 2, 1949, to Peter Kiewit Sons' Company of Arcadia, California. Three hundred working days were specified to complete the contract and the computed date for completion was July 17, 1950.

This work, totaling $967,000, was actually completed December 8, 1949, in just under 50 percent of the contract

Looking northerly from beginning of contract, showing Gorman Creek on left

time. This is a most unusual occurrence. Favorable weather conditions, an ample water supply, high quality subgrade material that handled well, and aggressive and efficient operation by the contractor, all combined to result in the speedy and satisfactory completion of this contract. The resident engineer for the Division of Highways was R. L. Deffebach, working under the general supervision of Frank B. Cressy, District Construction Engineer, and his assistant, C. P. Montgomery.

Another item of interest is the contract for which bids were opened on January 19, 1950, that will provide for an additional five miles of modernization of the Ridge Route. This section extends from 0.4 mile south of Castaic Creek to 0.4 mile north of Palomas Creek. The low bidder on this project was Basich Bros. Construction Company & Basich Bros., and W. C. Lefever & D. Gerald Bing. The contractor's low bid was $793,305.80. This contract will close the gap and connect to previously completed construction contracts so that there will be a four-lane divided limited access freeway on the Ridge Route extending continuously for 22 miles from Pico Canyon near Newhall to Piru Creek near Frenchman's Flat.

Plans are now in process of being completed for another 5.3-mile section of the Ridge Route between Frenchmen's Flat and Los Alamos Creek to widen and modernize to a four-lane divided limited access freeway the portion of the ridge through "Piru Gorge." This contract will probably be advertised for bids early in April.

FREEWAY UPS BUSINESS

Continued from page 8 . . .

owners along the freeway near off-ramps to North Sacramento more than offset any benefits of being located in view of the highway traffic.

One of the large advertising signs erected along the freeway by the North Sacramento motel owners to capitalize on the freeway's benefits may be seen in the accompanying photograph.

Owners in both locations indicate that approximately 90 percent of their tenants come from the south and west, and that well over half of their customers are "repeaters" who actually seek them out because of location, better service or purely personal reasons.

Little Effect on Motels

Both groups of motel operators admit a considerably higher occupancy rate than the state-wide average, which, as is commonly known, dipped drastically about the time the freeway opened in 1947, and has not since recovered.

This opinion poll of the motel owners in both locations leads us to the conclusion that a freeway has small effect on motels in general, and that the other variable factors such as quality of service, attractiveness of design, cleanliness, and personal managerial and advertising ability of the individual owners have more influence on motels than the construction of a freeway.

CONCLUSIONS

The analysis of gross retail sales has provided conclusive evidence of the benefits of the freeway to abutting businesses along the by-passed route.

It clearly indicates that the great bulk of through traffic operating in direct conflict with the local traffic which is really the potential customer, had almost reached the point of economic strangulation for the local merchants.

Now, because of the ease of maneuvering a vehicle on this business street and the lack of heavy congestion, nearly every operator of a vehicle is a potential purchaser.

The freeway's stabilizing effect on real estate values is amply demonstrated by the analysis of real estate sales, wherein it was found that the value trend has been consistently upward along the entire route of the former highway.

This healthy trend in the established business district, could only take place where the possibility of low-grade ribbon development, providing competition for the central business district merchant has been greatly reduced by freeway design of the new highway improvement.

The perpetuation of these benefits to business and property values has been guaranteed because it is inherent in freeway construction that abutters' rights of ingress and egress to the highway are acquired, which precludes competitive ribbon development springing up as always occurs along a conventional highway.

It is believed that as the Division of Highways completes and publishes each succeeding study of freeway effects on business and property values—the Fresno study in the November-December issue, the North Sacramento study in this issue, and the Auburn study now in progress—the many benefits of freeways to the areas by-passed will become as apparent as are the benefits to the traveling public.

Copenhagen Students Enjoy California Highway Magazine

Jean Sullivan, daughter of District Engineer E. Q. Sullivan, District VIII, is spending a year in Copenhagen, Denmark, attending the American Graduate School, which is a part of the University of Copenhagen. She writes:

"The *California Highways and Public Works* magazine which you sent has been a great success. After I read it I put it out on the table in the living room and I am certain that every single fellow in the Kolleguim has gone through it. They are quite amazed, particularly by the pictures and the special news about the recreational activities that are described. They are just a little bit unbelieving when it comes to the four-lane, divided highways and freeways.

"Recently there seems to be quite a bit of street repair work going on here and Dad would so enjoy seeing their methods. When it is a cobblestone street being repaired, one sees two men with pick and shovel carefully removing each cobblestone and placing it to one side. They then rearrange the dirt beneath and replace the cobblestone.

When the repair is completed they take a large wooden instrument that looks rather like a butter churner and stamp the blocks securely down. For paved streets one sees a mixer similar to a concrete mixer that we would use for house construction and out of this comes the black macadam. Four or five men work on these projects and there is always a large crowd about to watch the proceedings. To direct traffic they put up little red and white signs that read 'Pass Pao' meaning 'Take Care.'

"I have been in an automobile only once since I arrived, but my bicycle is excellent transportation and I love my little Denmark."

Erosion Control

Methods Used on California State Highways Discussed

By H. DANA BOWERS, Supervising Landscape Architect

California, a wrinkled ribbon of land more than 800 miles long lying between the high Sierras and the Pacific Ocean, stretches from the humid forested zone characteristic of the Pacific Northwest to arid northern Mexico, and ranges in elevation from below sea level to more than 14,000 feet. Climatic variations are extreme, as might be expected, and erosion control problems vary correspondingly. Many different types of control have, therefore, been found to be necessary.

The purpose of this series of articles is to discuss the variable factors associated with erosion which affect California roadsides, review the development of erosion control methods by the State Division of Highways, and describe erosion control processes now being employed with reasonable success to stabilize slopes on California state highways. This is the second installment.

It is felt that at least a few of the methods which have proved effective in California may be modified to suit conditions in other regions. Consequently, descriptions have been made as complete and are illustrated as fully as possible in order to permit duplication of these methods by nontechnical personnel.

The erosion problem on agricultural lands is another matter entirely. Since this phase of the subject is adequately treated in publications of the Soil Conservation Service we will consider here only erosion as it directly affects roadsides.

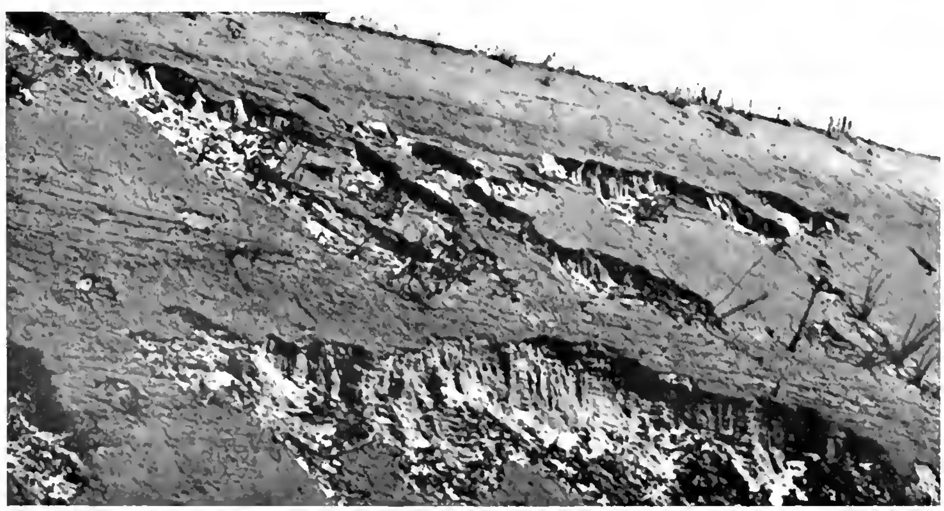
CONTROL OF EROSION ON CUT SLOPES

When soil is eroded from a highway cut slope, it is generally deposited in such a position that it blocks drainage ditches, causes diversion of water onto the pavement, or is actually deposited on the pavement with consequent hazard to traffic. All these situations require immediate attention by maintenance forces, and every maintenance man knows what it is to be routed out of bed on a stormy night to clear mud off the roadway. Emergency maintenance is expensive, and the cost of cleaning sloughed material from drainage ditches in the spring and summer is no small item. A gullied cut slope is unattractive from the standpoint of appearance, and is undesirable for that reason even though no direct expenditure of money is involved.

It was realized, of course, that an attempt must be made to stop, or at least reduce, the loss of soil from the slopes, since most of the soil which was washed from the slope had to be disposed of. Many methods of control were tried. Cut slopes were made steeper, the idea being that on a very steep slope, a smaller area of slope face would be exposed to the elements, and less water would accumulate on the slope itself. That idea worked pretty well when the rain came straight down,

UPPER—Active erosion on steep cut slopes. Vegetation cannot become established while soil particles are being constantly washed away. Note sloughed material which must be removed. (Near Salinas, Monterey County)

LOWER—Sandy cut slope south of Santa Maria, Santa Barbara County, which was stabilized by spraying with asphalt. The brittle coating has cracked, and failures are developing



but when the rain was driven by the wind directly against the slope face, the increased steepness of the slope caused the water to run off with greater velocity, causing more damage. Native vegetation found it impossible to establish itself on the steep slope; consequently, soil loss was continuous.

Runoff Water Restricted

Intercepting ditches were constructed at the top of each cut slope to prevent runoff water from above, from pouring over the cut face. This restricted the amount of runoff water which could cause erosion in the critical area to that which actually fell on the cut face, and was of decided benefit in reducing soil loss. This practice is now standard. These ditches lose their value, however, if they are not kept clean to allow free flow of water.

Low cuts are not subject to serious or rapid soil loss. Runoff water which accumulates on a low slope face does not attain sufficient volume or velocity by the time it reaches the lower portion of the slope to move much soil, though the process of soil loss, while slow, is sure. It is logical that if a high cut slope were broken up by means of water-catching terraces so that, in effect, it was made up of a series of low banks, the same low soil loss characteristics would apply to the entire slope. Terraces then must be constructed so that they will intercept runoff water and sloughed material from the slope above and lead the water to one side where it must be carried to the bottom of the cut in lined ditches or culvert pipe.

Board-faced, undrained terraces on a 1:1 cut slope are subject to undermining (Santa Barbara)

Method Works Well

This method works very well, provided the terraces are kept clean of slough so that no interference with the drainage system takes place; but the cost of extra excavation to form the terraces, plus the cost of lined ditch or pipe to dispose of runoff water safely, make it too expensive for any but exceptional cases. The appearance of a terraced slope is unpleasing because of the straight terrace lines which appear on the slope face. Mainly, however, it is a mechanical approach to a problem that can only be permanently solved by natural means.

Waterproofing a slope by coating the soil with an impervious substance is another mechanical and generally ineffective method. Unattractive appearance and cost of treatment, plus high maintenance cost, if a brittle substance is used, make this method impractical except in extreme cases.

A thick (6±") uncompacted topsoil blanket slips from 1½:1 slope when saturated (Near Castroville, Monterey County)

A straw-covered, topsoiled, 1½:1 cut slope near Salinas after compaction with a sheepsfoot roller

Soil loss after a high-intensity storm on an untreated fill slope in the vicinity of Watsonville. This slope later received seed and straw treatment and is now perfectly stabilized

The foregoing methods are all mechanical ways of combating natural forces. Observation of naturally formed slopes showed that native vegetation growing on the slope did a pretty good job of erosion control, and, furthermore, the appearance of such a slope was not unattractive because it *was* natural.

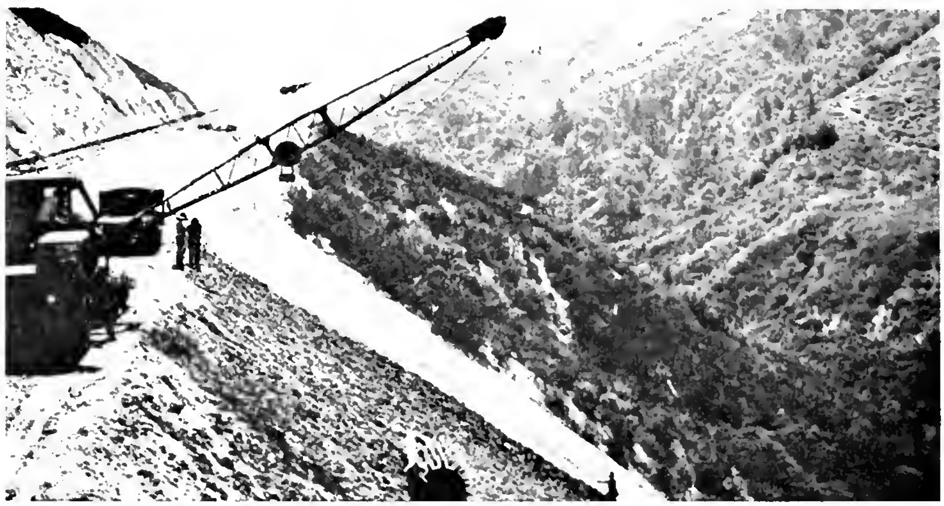
Thick Vegetative Cover

Attempts were made to establish vegetation on new 1:1 cut slopes. Grass and grain seed, cuttings of ground cover plants, and seed of native plants were planted on the steep slopes. For the most part, results were disappointing. Vegetation grew well at the top of the cuts where some topsoil had been left after slope-rounding operations were completed, and if the slope face was rough enough to form pockets which could hold topsoil, little tufts of vegetation grew in the pockets. The bare, smooth, exposed subsoil, however, could not maintain plant growth which was vigorous or dense enough to protect the entire slope from erosion, and the soil loss which took place during the establishment period was nearly as great as on untreated banks.

Favorable results obtained from some of these tests indicated clearly that a thick vegetative cover was effective in preventing loss of soil from the slopes. In order to establish this desirable thick vegetative cover, it is necessary to cover the sterile slope with a blanket of topsoil in which the plants can grow. The angle of repose

Terrace Slopes Eroded

The accompanying illustration shows what happens when small undrained terrace, are constructed on a 1:1 cut slope in an attempt to create favorable conditions for ground cover plant growth (in this case, Mesembryanthemum). A ditch was dug in the slope, faced with a length of 1-inch x 4-inch lumber held in place by stakes, and the resulting space backfilled with topsoil, and planted. Runoff water overtopping the board facings dropped to the slope below, eroding the steep slope between terraces. Board facings were undermined, and further loss of saturated topsoil took place. As the illustration clearly shows, this method proved to be both expensive and unsuccessful.



Rolling straw-covered 1½:1 slope with a sheepsfoot roller (City Creek Road, San Bernardino County)

Brush layer in place ready for a covering of soil, which is then compacted (City Creek Road, San Bernardino County)

of loose soil is approximately 1½:1. It will sometimes stand on a steeper slope, but when saturated will slump and come to rest in an ungraceful heap at the bottom of the slope. Since it was obviously impossible to blanket a 1:1 cut slope with loose topsoil with any assurance that it would remain on the slope, even when dry, it became necessary to flatten the cut slopes to a minimum of 1½:1 in order to retain topsoil.

Small gullies caused by runoff water from the pavement (Box Springs Grade, Riverside County)

Slippage Overcome

A blanket of loose topsoil six inches or more in thickness was spread evenly on the smooth cut slopes; but if the first rain of the season amounted to several inches, this loose soil, becoming saturated, slid to the bottom of the slope, leaving the smooth subsoil exposed. It was found necessary to roughen the subsoil slope face and reduce the thickness and weight of the topsoil blanket in order to overcome the tendency toward slippage. A topsoil cover less than three inches in thickness was found to give as satisfactory results as a thicker blanket, since density of growth, not size of the individual plant, is the desirable condition.

Vegetative protection in a dividing strip on an approximate 5 percent grade. No damage is evident. (Between Watsonville and Santa Cruz, Santa Cruz County)

The combination of 1½:1, or preferably flatter slope, well roughened cut face, and relatively thin blanket of topsoil, seeded with grain or grass seed, works very well in all but the most erosive types of California soils. Barring the years when an "unusual" amount of rain falls at the very beginning of the rainy season, soil loss is not great before vegetation becomes established, and is negligible thereafter.

Highly Erosive Soil Types

The highly erosive soil types, however, offer additional problems. Some soils seem to melt like sugar under the influence of rainfall, and when treated as above, the soil loss during the first year is so great as to make it almost impossible to establish vegetation on the slope.

To solve this problem, straw was spread over the topsoil after seeding in an attempt to duplicate the humus existing on natural slopes in the vicinity. The straw retarded surface erosion by decreasing the velocity of runoff water. It also encouraged the germination of seed but increased the tendency toward saturation and consequent slippage of the topsoil. Stakes were driven through the topsoil layer and into the subsoil in an attempt to anchor the soil and straw in place, but this proved unsatisfactory.

A sheepsfoot roller was used on the mulched and topsoiled slope in order to compact the topsoil to the point where its water-holding capacity would be reduced, and the tendency

An unvegetated drainage ditch may erode to the point where the roadway is threatened (Box Springs Grade, Riverside County)

of the soil to liquefy would not be so pronounced. The roller was rigged and operated as described later and performed the double function of compacting the slope surface and incorporating the straw with the soil in one operation.

This method gives very satisfactory control of even the most erosive soils during years when rainfall is normal, but partial failure results due to slippage when rainfall exceeds three inches to four inches in a single storm during the first year after treatment.

An unattractive intercepting ditch. Culverts may be clogged with eroded material when this type of soil loss occurs (Near Shingle Springs, El Dorado County)

EROSION CONTROL ON FILL SLOPES

When soil is eroded from fill slopes, the immediate effect on the traveled way is not often serious. The usability of the highway is generally not immediately affected, and unless a slipout takes place or a gully erodes to the point where it starts eating into the roadway, these minor soil losses have generally been disregarded until the small gullies have attained major proportions. By that time, extensive repairs are necessary in order to save the highway.

Vegetation, of course, offers the most economical and effective means of control.

Results of sowing seed on raw fill slopes before the soil had been consolidated by rain, were very encouraging. In all but highly erosive or very infertile soils, one seeding usually produced a sufficiently dense cover to give adequate control after the first year. Old fill slopes which had been consolidated and gullied by rainfall before being seeded showed poor results, much like those obtained on smooth cut slopes, unless roughened by cultivation before seed was sown. Under some conditions it was found that an application of straw mulch or some type of humus was necessary in order to prevent the gullies from redeveloping before the seed germinated. An effective cover was established on very infertile soils after an application of fertilizer or a thin blanket of topsoil was spread on the slope. The results of sowing seed on new fill slopes before they are consolidated by rain are usually so successful and the cost is so relatively small that this practice should be followed on all newly constructed roads.

A broad, flattened, intercepting ditch. Vegetation may easily be established here, and a large volume of water carried without damage (Near Castroville, Monterey County)

Control by Seeding

While seeding alone (at times supplemented by a straw mulch) gives adequate control in localities where the soil is neither highly erosive nor subject to heavy concentrations of rainfall, more elaborate treatment is necessary where conditions are extreme. Loss of soil due to gullying and sheet erosion may be retarded during the critical first season before vegetation has become established, by applying straw as a mulch. The straw protects the soil surface from the impact of the raindrops, and slows the runoff water down to the point where its velocity is so low that its soil-carrying capacity is practically nil.

Theoretically, a small quantity of water runs from straw to straw and reaches the bottom of the slope without touching the soil at all. If it were practicable to "thatch" slopes with a thick covering of straw, each straw running in the same direction, the problem of surface protection should be solved until the straw rotted, or became displaced. However, it is desirable that enough moisture be absorbed by the soil to support plant growth, which will give permanent protection, so waterproofing the slope does not completely solve the problem.

The protection given the surface by a straw application is effective only as

long as the covering remains unbroken. If a culvert or berm fails or is overtopped, thereby concentrating a quantity of water in a single area, the straw covering is washed away in a short time and the gully deepens rapidly. If workmen, children, or animals have made trails or have otherwise disturbed the cover, gullies may form.

Frequent Inspections

In order to give the protection of which it is capable, a straw covering must be inspected at frequent intervals, especially during the first season, and disturbed areas seeded and repaired with additional straw before extensive damage is done.

Unfortunately, one of the advantages of a straw covering from a surface-protection standpoint, turns out to be a distinct disadvantage in another way. Straw reduces the velocity of the runoff water, and as a result percolation of water into the loose outer layer of the fill material is increased. Most of our California soils will slump, slide or run like molasses when saturated, so some means had to be provided to decrease the amount of water which could be absorbed by the soil and also to anchor the outer layer which is subject to slippage.

A sheepsfoot roller was run over the completed slope (as described later) in order to compact the soil. Since the straw is spread on the slope in advance of rolling, it is incorporated with the surface soil as the compacting is done, thus performing two operations simultaneously. A sheepsfoot roller leaves a few inches of loose uncompacted soil on the surface, but this loose soil is mixed with straw and forms a good seedbed for the grain seed which is sowed as part of the complete treatment.

Compaction on Slopes

A relative compaction of 89.4 percent was obtained below the top four inches on a disintegrated granite fill slope which had recently been given six round trips of a standard two-section sheepsfoot roller. This degree of compaction reduces the water-holding capacity of the soil by reducing the number of voids, and the tendency of the soil to liquefy is not so pronounced.

On deep fill slopes composed of highly erosive material, a mechanical anchoring effect may be obtained by the use of wire-reinforced brush mats, straw or wire-mesh mats, or brush layers installed on the contour during fill construction. The various types used are described later. All types are placed flat during construction, on a contour level, with the outer edge of the mat or layer flush with the surface of the fill, and the inner edge buried about five feet in the solidly compacted fill material. The relatively loose outer layer of soil is thus stabilized to a large extent, even when saturated.

Mats Act as Screens

The mats and layers are also designed to act as screens or filters in the event the surface straw protection does not completely prevent movement of soil particles. If gullies start to form due to failure of the straw covering, the mats or layers are exposed, and by filtering and decreasing the velocity of the water, tend to keep the damage to a minimum. Thus the mats and layers act as a second line of defense and are not utilized, except as mechanical anchors, unless the surface protection fails.

The outer edge of the mat is left flush with the surface of the fill slope to allow for use of a sheepsfoot roller in compacting the loose surface material and imbedding straw in the soil without disturbing the mat.

A further reason that brush should not protrude beyond the slope face is based on observation of brush-layer-treated slopes on which the brush had been allowed to protrude 12 inches or more from the slope. Where any soil movement whatever took place, the filtering action of the brush caused terraces to build out on the protruding brush layer to the point where runoff water, overtopping the terrace, dropped straight down, striking the slope below with considerable force. Holes were gouged out in the slope below the layer, and the displaced fill material which was carried down to the next brush layer accelerated the formation of a terrace at that point.

Conclusion Reached

This same effect takes place, of course, when the brush layers which

Cut brush placed in eroded drainage ditch arrests active erosion (Near Tunitas, San Mateo County)

have been constructed flush with the edge of the fill, are exposed by failure of the surface protection. The terraces are not built up so rapidly, however, and are confined to the actual gully area.

The conclusion has been reached that since no method of erosion control yet observed is completely successful during the first year under extreme conditions, a treatment which is relatively inexpensive to install and which can be used to repair failures as soon as they are observed seems more practical on a long-term basis than more elaborate and costly methods.

Findings of Conference

The following paragraph is taken from a paper entitled, "Erosion Control Specifications for Southern California," which summarizes conclusions reached at a conference between representatives of the U. S. Forest Service and the California Division of Highways in April, 1946:

"Material excavated from cuts and placed in fills in mountainous areas is not a soil but a broken and shattered rock, which is incapable of supporting vegetation until soil forming processes have had an opportunity to operate. Where this material comes from a rock which is geologically fresh, it is usually in rather large

fragments and does not contain sufficient fines to retain moisture and support growth. Plant food elements may be sufficient in the parent rock, but they are not available until degeneration takes place. Natural revegetation can not succeed until such time as this material becomes a partly developed soil. This requires weathering, the introduction of organic matter with the consequent formation of humus, and the development of soil bacteria for nitrogen fixation and assistance to plant growth. Where the fill does not naturally contain at least 60 percent of material passing the No. 12 sieve and 18 percent passing the No. 200 sieve, the period required for sufficient weathering to take place to make a soil capable of supporting vegetation is too long for economic consideration. To overcome this condition, sufficient fine material must be added to meet this specification in the outer two feet of the fill material."

Concrete check dams retard velocity of runoff water on a steep grade (Between Bradley and Jolon, Monterey County)

EROSION CONTROL ON HIGHWAY SHOULDERS

Damage due to erosion on highway shoulders is generally confined to the development of numerous rills or small gullies in highly erosive granular material caused by runoff water from the pavement. This development is most likely to occur during the first year after construction, before the shoulder has become stabilized by traffic compaction and a growth of vegetation, but seldom thereafter.

In view of the temporary nature of this problem and the simplicity, effectiveness and low cost of the curative treatment herein described, it would seem that construction of an expensive bordering plant-mix berm for the sole purpose of stopping off-pavement erosion may not always be justifiable.

Since erosion damage to shoulders, even when normally erosive imported material is used, is almost enrirely dependent upon the intensity of the rainfall during the first year, erosion protection is not given shoulders as a matter of course. If rills develop, a thin coating of straw spread at the rate of approximately three tons per acre, is scattered over the affected area and a sheepsfoot roller is run over the straw, thus punching it into the soil. Under extreme conditions, the area is seeded, though normally an adequate grass cover is obtained from seed contained in the straw and from native vegetation which will establish itself after the first rainy season.

Dividing Strip Protection

Uncurbed center dividing strips are subject to the same type of damage, and curative measures are much the same as those described above. Additional protection may be found necessary in the low center which becomes a drainage ditch, but well vegetated ditches of this type running on grades as steep as 5 percent have been disposing of runoff water without loss of soil. Where climatic conditions are favorable, an evergreen ground cover planting will solve the protection problem.

Establishment of evergreen turf on highway shoulders, as is done in regions which receive summer rainfall, has not been found practical in California. No perennial grass has yet been found which will survive the long dry summer season without being given artificial watering. On metropolitan freeways where elaborate landscape treatment justifies the installation of a sprinkling system, a strip of grass can be established on the shoulder to act as an emergency parking area and to control dust and erosion, but for the most part, in rural areas we must depend upon annual grasses and weeds to hold the soil.

EROSION CONTROL IN DRAINAGE CHANNELS

Every highway user is familiar with the sight of eroded drainage or intercepting ditches, which are both ugly in appearance and potentially dangerous to traffic. So far, little consideration has been given to the possibility of preventing this damage, yet methods have been developed which offer an effective and inexpensive means of control if applied at the right time, which is during construction.

An unvegetated ditch, formed in soil which is even moderately erosive, cannot carry an appreciable amount of water on a grade steeper than 2 percent without losing soil. As the grade of the ditch becomes steeper, the velocity of the water increases, and, of course, the rate of soil loss increases with the velocity. That is elementary. Yet new ditches are still being built on steep grades by equipment which forms a V-shaped ditch with the point of the V extending into the infertile subsoil —an open invitation to erosion.

Ditch Problem

Quite often, it is true, the ditch is not called upon to carry water until vegetation has established itself naturally where it can find a foothold, and erosion is lessened or eliminated by the

retarding effect which the vegetation has upon swiftly moving water. However, when the intensity of rainfall during the first year after construction is so great that the ditch must carry runoff water, the bottom of the ditch will usually scour clean and the hard subsoil which is then exposed offers no foothold in which windblown native seeds can lodge. Lacking protection, the ditch gets deeper with every storm, and as the depth increases, the likelihood of natural establishment of a protective growth of weeds and grasses becomes less and less.

A ditch formed in a broad U-shape instead of the sharp V-shape, need not extend as deeply into the infertile subsoil in order to carry an equal amount of runoff water. Concentration of water in a single channel is reduced. If the bottom of the ditch is cultivated, covered with a thin layer of topsoil if necessary, and seeded with a quick-growing annual grain immediately after construction, protection may be obtained during the critical first year, and the windblown native seeds caught by the grain stalks will establish a permanent cover quite rapidly.

Intercepting Runoff Water

While the broad U-shape is most desirable, it is admittedly impractical to construct a ditch of this shape on steep grades with equipment now in general use. Too much hand work is necessary. An alternate method of intercepting runoff water may be employed, if space and character of the soil permit. A thin layer of topsoil is scraped from the slope immediately above the top of the slope face, and formed into a low rounded berm which merges into the rounded brow of the cut. This may be done with a motor grader. The disturbed area is then cultivated and both it and the berm are heavily seeded. Concentration of runoff water in the area immediately behind and against the berm takes place, of course, but conditions for vegetative growth are so much more favorable in the topsoil of which the berm is composed that growth is usually rapid and dense.

Well vegetated ditches of this type are capable of handling intermittent runoff water effectively, and under normal conditions no erosion takes place even on steep grades.

Straw Mulch Used

A straw mulch may be found necessary, under certain conditions, to afford immediate protection from erosion before the nurse crop appears or even to stop developing gullies in a partly established planting, but this additional treatment is seldom required.

Under certain conditions the construction of contour ditches at the ends of cut slopes makes it possible to dispose of runoff water without inviting soil loss. If the right of way is wide enough, and the shape of the end slope permits, water can be directed away from the roadway to a dispersal area or, if the adjoining property owner does not object, to the naturally sodded field beyond the fence line where it can do no damage.

Erosion damage in roadside ditches which run on a moderate grade may be stopped relatively easily. Cut brush, packed into the ditches, supplemented with straw, if the brush is coarse in texture, will filter soil particles from the water and reduce the velocity to the point where no further cutting action takes place. With active erosion eliminated, vegetation has an opportunity to become established and, if given a little encouragement, will form a permanent protection. Where possible, diversion of a portion of the runoff water through a supplementary channel until vegetation has become established is advisable in order to hasten the stabilization process.

Check dams are sometimes necessary when the soil is very erosive and the grade is long and quite steep. Those used along our highways are usually made of concrete, and are so placed that the grade from the foot of one to the crest of the next does not exceed 2 percent.

. . . To be continued

ACKNOWLEDGMENTS

Grateful acknowledgment is hereby made to the many persons who, by their suggestions and encouragement, have contributed to the preparation of this booklet.

Special acknowledgment is due Mr. Chas. C. Morris, Division Engineer of the Public Roads Administration, for suggesting that a publication describing our erosion control methods would be of interest to others faced with similar problems; and later for his review and suggested improvements in the manuscript. Also to Mr. Wilbur H. Simonson, Chief, Roadside Section, Public Roads Administration; Mr. C. J. Kraebel, Division of Forest Influences, U. S. Forest Service; Mr. J. S. Horton, San Dimas Experimental Forest, U. S. Forest Service; Professor Joseph Kittredge, Professor of Forestry, Forest Influences, University of California; and Mr. C. H. Gleason, Forester, U. S. Forest Service, for their valuable suggestions and constructive criticism; and to Mr. L. S. Manning, Associate Landscape Architect, California Division of Highways, for his compilation of this manuscript.

H. DANA BOWERS

THANK YOU, MR. BAEN

C. E. BAEN
1 Sansome Street, San Francisco

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: I have had the pleasure of receiving your interesting magazine for many years, and find it interesting and informative. The November and December magazine is exceptional and outstanding. The picture on the front cover is beautiful, factual, and artistic. The information relative to highway construction is exceptionally good.

Very truly yours,

C. E. BAEN

FROM LONDON

MINISTRY OF CIVIL AVIATION
Department C. W. 1

ARIEL HOUSE, LONDON, W.C.1.
November 30, 1949.

THE EDITOR
California Highways and Public Works
Sacramento, California

DEAR SIR: It is almost a year now since you forwarded me my first copy of your magazine *California Highways and Public Works*, and I should like to take the opportunity of expressing my sincere appreciation of this excellent publication. My staff and I have derived great benefit from the very fine articles, and we look forward to receiving copies in the future.

Yours faithfully,

W. J. COZENS

Pigeon Pass Road

A Story of Cooperation Between Federal, State, County Agencies

By J. E. RIEBE, San Bernardino County Highway Department

"It ain't the guns nor armament,
Nor funds that they can pay,
But the close cooperation
That makes them win the day.

"It ain't the individual
Nor the army as a whole,
But the everlasting teamwork
Of every blooming soul."

J. MASON KNOX

When J. Mason Knox wrote those lines he did not know how well they could be applied to the design and construction of Federal Aid Secondary Project S-714(2), Pigeon Pass Road, a San Bernardino County road.

The appreciative traveling public using the road, the bystanders who watched its construction progress and even the administrative officials who made the project possible, do not know the full story; nor does the following brief description tell the story of Pigeon Pass Road.

From the preliminary review to the acceptance date, the cooperation and assistance given the county by federal and state engineers was invaluable. Particular commendation in this respect is due H. A. Alderton of the Bureau of Public Roads, Clyde Kane, Assistant District Engineer, Almon Coonrod, District Office Engineer, Berndt Nelson, District Construction Engineer, and Loran Moore, District F. A. S. Engineer, all of District VIII of the California Division of Highways. Anyone observing the teamwork employed on F. A. S. projects in San Bernardino County by these men of District VIII and the county highway engineers would hardly realize that two separate governmental agencies were involved.

Important Route

Pigeon Pass Road was the sixth road improved under the federal aid secondary program in San Bernardino County. It connects Redlands and the surrounding citrus and agricultural areas, Bryn Mawr and Loma Linda with major cross-valley routes to San Bernardino and state highways and, also, acts as an important route for intercounty traffic going to and from the beach resorts and mountain resorts. Thus, besides being a fully qualified federal aid secondary route, that is, a feeder road, a farm-to-market road, a R. F. D. route or school bus route within this county, Pigeon Pass Road is an important route to communities and cities in counties adjacent to San Bernardino County.

Before being improved, Pigeon Pass Road, 8.3 miles in length, was of poor alignment both vertical and horizontal, and paved with bituminous macadam varying from 20 feet to 26 feet in width and in poor repair. The radius of horizontal curves varied from 150 to 1,500 feet and there was one right angle turn and several points of sharp reverse curvature in the old road.

Dangerous Curve Removed

There was a particularly hazardous condition in the unincorporated community of Loma Linda where the old road made a right angle turn and a sharp compound curve in the business center.

The old alignment, also, made a sharp and dangerous reverse at Pigeon Pass.

The new alignment eliminated all points of reverse and compound curvature and replaced all short radius curves with radii varying from 600 to 4,000 feet in length. The community of Loma Linda was completely bypassed by constructing approximately 0.9 mile of new road through undeveloped area south and southwest of the town. The new road was realigned through Pigeon Pass by abandoning the old alignment and constructing a new road with 900-foot radius curves with ample transition tangent between curves.

High Standard 2-Lane Road

The type of improvement agreed upon by county, state and federal

---

DESERVING TRIBUTE

COUNTY SUPERVISORS ASSOCIATION OF CALIFORNIA

SACRAMENTO 14, CALIFORNIA

CHARLES H. PURCELL, *Director*
State Department of Public Works
1120 N Street
Sacramento, California

DEAR MR. PURCELL: This office has just completed five regional meetings with the various county supervisor groups in the State. These meetings were very successful and Mr. H. B. LaForge of the federal aid secondary road program was present at each of the meetings to appear along with the staff.

I am writing this letter to you to express the appreciation of our officers and staff for making Mr. LaForge available for these meetings. His familiarity with the federal aid highway program plus his knowledge of how county supervisors think and work made his appearance most successful. From a public relations standpoint he did an excellent job for the Division of Highways before these meetings of supervisors.

Many of the questions and problems which had arisen in the minds of the supervisors and road commissioners in view of the recent legislative action in respect to the continuance of the federal aid highway program were answered by Mr. LaForge in a frank and candid manner. I think he did much to stimulate the interest on both the part of the supervisors and road commissioners in advancing plans for highways.

Our sincere thanks go to you for making Mr. LaForge available and we congratulate you for having a man of his training and caliber on your staff.

Sincerely yours,
(SIGNED)

FREDERIC L. ALEXANDER
General Manager

UPPER—View on Pigeon Pass Road looking east from Benton Avenue toward Redlands. LOWER—Looking east from west of Terracina Avenue

engineers was to construct a high standard two-lane road with adequately developed intersections. Although the old road was carrying approximately 3,000 vehicles per day at some intersections, it was felt that it would not be necessary to construct a larger capacity road at present or in the foreseeable future because of the close proximity of State Route 26, a four-lane divided highway, parallel and from one to two miles to the north of this project.

It was decided to construct a roadbed 50 feet in width and place thereon two 11-foot traffic lanes with eight-foot paved parking shoulders on both sides. The condition of the old pavement was such that, except where realignment was made, it was utilized as a base for new pavement. The bearing quality of natural ground through areas of new construction and adjacent to the old pavement was insufficient for the anticipated traffic load and imported base material varying from 6 to 12 inches in thickness was placed over all natural ground.

A maximum of four inches of plant-mixed surfacing was placed over imported base material and a minimum of two inches was placed over old pavement.

Culverts Replaced

Practically all culverts and drainage structures on the project had to be replaced by greater capacity facilities. The construction cost of the project was considerably increased for this reason, but it was felt that this cost would be more than compensated for by future low maintenance cost.

At the intersection with Waterman Avenue, F. A. S. 712, a major connection to San Bernardino, Pigeon Pass Road crossed the Gage Canal at an acute angle. In order to widen and channelize this intersection it was necessary to construct an additional 120 feet of cover over the canal. Since this work had to be performed in such a manner as to cause the minimum of interference to the normal operation of the canal, it was decided to construct a reinforced concrete cover on steel "H" piles driven along the sides of the canal. This plan proved very satisfactory and construction was performed with no inconvenience to the Gage Canal Company.

UPPER—Old road through Pigeon Pass. LOWER—New, relocated highway

Pavement Problem

From Waterman Avenue west for a distance of approximately 1.3 miles Pigeon Pass Road parallels the Gage Canal at a lower elevation. An interesting and unanticipated construction problem arose from this situation after the project was under construction. The existing pavement which was to be resurfaced and widened gave all indications of being a sufficient base for the proposed resurfacing; however, when heavy grading equipment started hauling across this section of road

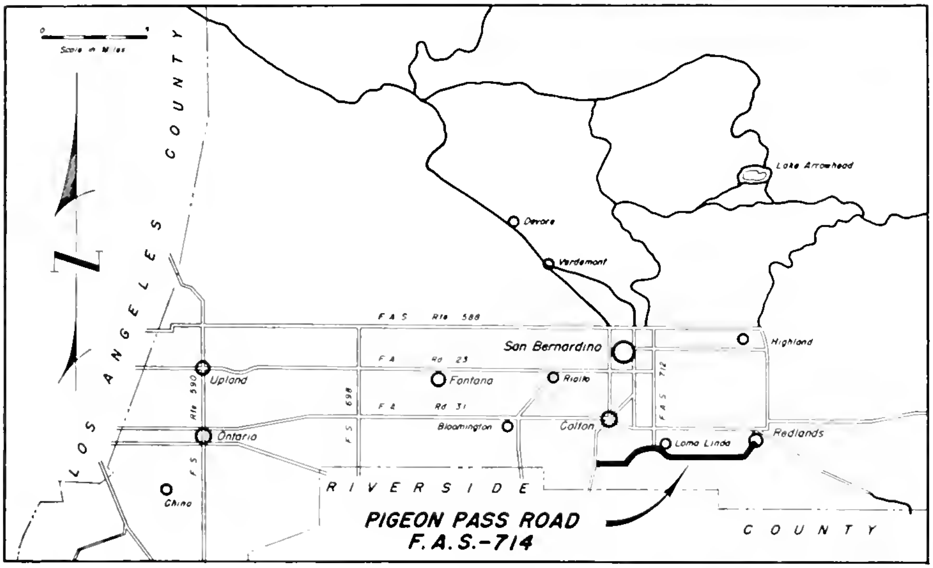
holes and breaks developed in the old pavement.

Investigation disclosed that the underlying soil was in a saturated condition because of seepage from the Gage Canal, the lining of which was cement mortar approximately one inch in thickness.

As a solution to this, the original plan of utilizing the old pavement as a base was abandoned and a base of imported base material was constructed in lieu thereof, and an underdrain of 4-inch tile in crushed filter material with cross-drains was placed between the highway and canal. The result was entirely satisfactory.

The contract for the project was awarded to Basich Bros. Construction Company of San Gabriel on January 7, 1949, and the work was completed on September 2, 1949, a date far in advance of the anticipated completion date. The advanced completion date can be partially accredited to the contractor's plant-mixed surfacing operation whereby an average of 1,360 tons per day was produced by the use of a continuous mixing plant.

Construction scene on Pigeon Pass Road



The cost of construction, exclusive of engineering, was $427,000 which was financed in whole with Federal Aid Secondary and state matching funds. The cost of preliminary engineering and right of way was borne by the county. The design and construction was under the supervision of the writer working as previously mentioned, in close cooperation with District VIII personnel.

"The performance of engineering work on this project," said State Highway Engineer George T. McCoy, "is an excellent example of what the Division of Highways hopes for and expects from county engineering forces on F. A. S. projects."

Widening and channelizing intersection at Waterman Avenue necessitated 120 feet of additional cover on Gage Canal

An Effective Job

Erosion Protection on New City Creek Road Tested by Storm

By A. COONROD, Office Engineer, District VIII

PLANNING of the City Creek highway, an all-year traffic route into the San Bernardino Mountains, necessitated design of deep cuts and high fills to secure a sufficiently high geometric standard to accommodate the future volume of traffic. The terrain has a cover of natural brush and, though steep and rugged, has, through the ages, become erosion resistant. Destruction of the brush cover and the creation of fresh cut and fill slopes upsets this natural stable condition of the ground surface with resultant landscape disfiguration, roadbed destruction, and stream pollution.

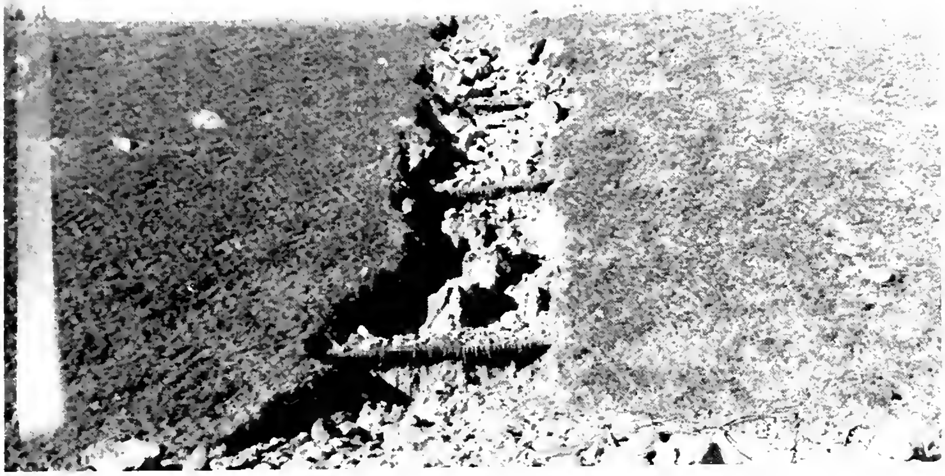
The article in the September-October, 1948, issue of *California Highways and Public Works* describes our efforts to correct this destructive action by placing horizontal wire mats, rolling in Santa Anita bedding straw, seeding, and planting.

Wire mats have been placed at 10- to 15-foot vertical intervals in the sides of fills in horizontal position as the construction has progressed upward in horizontal layers. They have been made up about 60 inches wide and were at first composed of a layer of brush compressed between two widths of wire mesh fencing with four square-inch openings. Later, due to scarcity of brush, camouflage netting covered with steel wool was substituted for brush.

On the project now in progress, steel army cots purchased from war surplus, at 43 cents each, have been used. These are laid and wired together two side by side parallel to the roal followed by one projecting endwise into the fill with a course of chicken wire on top. The outer edge of the mats is laid six inches inside the fill slope to avoid interference with rolling in straw cover.

The rolling in of straw cover is accomplished by hand-spreading of straw and rolling with a modified sheepsfoot roller drawn up and down the slope by a cable and drum powered

UPPER—Army cots in place prior to placing a course of chicken wire followed by succeeding layers of embankment. CENTER—This 130-foot high fill suffered minor gullying stopped by the horizontal mats. Straw protection would have prevented this. LOWER—Protected slopes properly diked on top showed no failure



UPPER—This roller drawn up and down slopes incorporates straw in the embankment surface. CENTER—This break over from the gutter took out the straw cover and exposed the edges of the horizontal mats proving their great value as secondary protection. LOWER—After the storm the contractor threw up temporary dikes to protect his investment in protected slopes

from the motor of a truck. The contractors have continued to use Santa Anita race track bedding straw due to its low cost. It is further desirable due to its fertilizing value.

Seed consisting of 50 percent barley or winter wheat, 45 percent rye, 3 percent alfalfa, and 2 percent mustard is broadcast on slopes at the rate of 200 pounds per acre prior to rolling in of straw. Vegetative cover is augmented by hand planting (principally of Baccharis cuttings) during favorable seasons by day labor.

We have hoped that before long the effectiveness of our work would be proved, and the storm of November 10, 1949, was an event we were waiting for. There were, on that day, fills in every stage of construction from one day to three years of age. The storm was continuous for 10 or more hours, of varying intensity, and with a total of 3.5 inches of rainfall.

At places the contractor had not fully protected his straw cover by dyking the edges of fills and installing downdrains, and occasional streams broke over the top of fills, washed out strips of the straw cover and exposed the edges of the horizontal mats. This was destructive to the contractor's work but enlightening to the engineers in that it gave them an opportunity to observe the effectiveness of the horizontal mats.

Failure of the horizontal mats occurred only at one location where a stream of considerable volume broke over at a sharp junction of a fill slope with a steep hillside. Such failures were not due to faulty design because when the project is completed the water will be carried along the top of slopes in paved gutters and discharged through metal downdrains to areas that are immune to erosion.

The function of the horizontal mats is to form a secondary defense against mishaps that may occur; for instance, gutter-clogging from an overload of debris that might cause a stream of water to break over the protective dike too intense to be withstood by straw cover or insufficiently rooted plants. They operate by breaking up the knife-edge gullies that form. When a portion of the mat is uncovered, the mesh openings become filled with

small rocks which, in turn, hold finer particles to form a cover that carries the water to the out edge of the mat. The destructive energy of the rivulet is broken up through lateral spreading followed by short vertical drops and splattering. By the time it re-collects into the next sharp gully, the next lower mat is reached and so on down the fill. A fill protected by mats only, may become gullied, but this is only an unimportant surface condition. In no case were gullies deep enough to cut back of the mats except the one instance mentioned above.

Deeper gullying is to be expected at the extreme toe of high fills due to concentration of flow through narrowing and accumulation through the greater distance from the top of the fill. On one fill 130 feet high, protected only by horizontal mats, failure did not occur.

There are three controlling features in design of horizontal mats:

1. The mesh must be fine enough to catch and hold sufficient coarser particles to render the mat fairly water tight.
2. The fabric must be strong enough to span gullies three to four feet wide in order not to give way or sag, thereby nullifying the lateral spreading effect essential to success.
3. The material should be low in cost; hence the use of surplus war material such as camouflage netting and steel cots.

Although not a cure-all, the straw cover has value and has proved its worth. Barring mishaps causing runover from the roadway gutters, straw cover withstood the storm of November 10th and acting alone prevented forming of rivulets and gullying even on high fills. This cover deteriorates as the straw decays, and the ultimate success is dependent on rooting of plants from seed and cuttings.

Well-aged fills where rooting has taken place showed no damage. Along with rooting, aging has the further effect of allowing light and semisoluble material to be washed away leaving a cover of coarser particles, to some extent, cemented together.

In effect, our efforts have been toward assisting natural forces in their work similar to treatment of a wound to cause proper healing reducing the scar to the minimum.

The heavy rain of December 18, 1949, was absorbed by the straw-protected surface until it became semiliquid and flowed in streaks, or slipped in mass, down the slopes

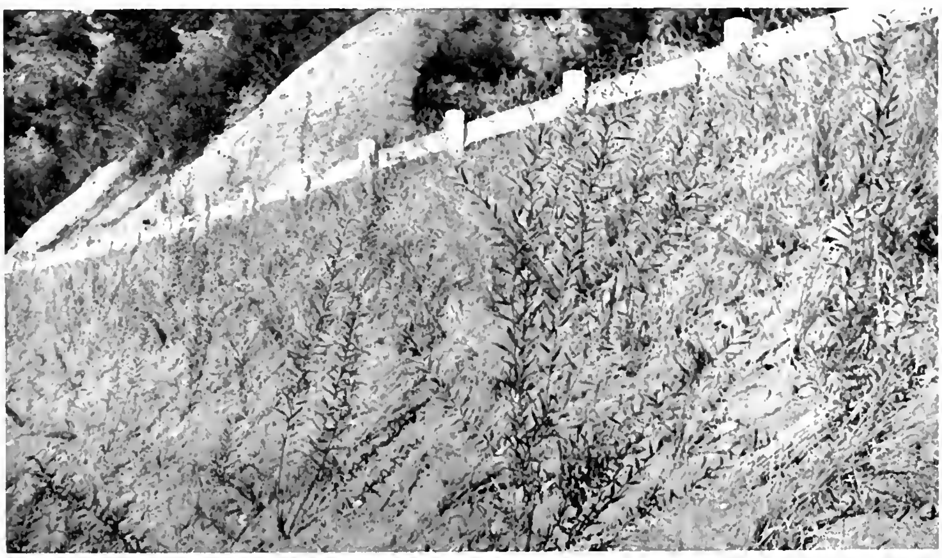
High Intensity Storm

Since the original writing of this article a storm of 24 hours' duration and seven and one-half inches of rain occurred on December 18, 1949, further testing the effectiveness of our work, and adding to our experience in retaining embankment surfaces in altitudes where storms of such high intensity occur.

The contractor had fully protected his fills by dyking, thereby preventing the usual washouts from gutters breaking over the top. With this intensive soaking the straw protected surface absorbed its limit of water, became semi-liquid, and flowed in streaks, or slipped in mass, down the slopes. The areas left unprotected by straw did not gully badly and very few edges of horizontal mats were exposed. The damage was to the straw protection only, which can be replaced at low cost.

The project was started in 1946 and will be continued to completion sometime in 1951. The work has progressed from the lower to the higher altitudes, ranging from 1,800 to 6,000 feet above sea level. The vegetative cover is more difficult to replace in the higher altitudes. Before the entire project is completed, the protective work may be put to more severe tests by more intense storms, and this subject may furnish material for later articles.

Vegetative cover taking over on a 1½-year-old fill. Work of this age showed no ill effects from the storm of November 10th



Big Blow

Relocation of Huge Gas Line Provides Thrills for Field Crews

By CHARLES B. MACKEY, Right of Way Agent, Utilities

At 6 o'clock on the morning of Saturday, June 4, 1949, the residents of Corona and the nearby farming community were awakened by the loud shrill whistling sound of gas being released under 620 pounds of pressure from Valve No. 21 on the Texas-to-California 30-inch high-pressure gas line. This was done in preparation for the rearranging of that high-pressure line owned by the Southern California and Southern Counties Gas Companies, and was necessary because of highway construction being carried on to relocate State Sign Route 71 outside of the area subject to flooding by the new Prada Dam in Riverside County.

This highway improvement now well started under the contract of A. Teichert and Sons of Sacramento, will provide grading and paving of 7.5 miles at a cost of $600,000.

Interesting Job

This was the first time that this line had been purposely cut into for rearranging in any manner, and the methods used, and the laying out of the work, created considerable interest. Representatives from the Pacific Gas and Electric Company, and the El Paso Natural Gas Company, were present to observe developments.

Because of the terrific noise caused by the blowdown, the gas company in accord with its usual practice, notified the Police Department of Corona, the Fire Department of that city, the Sheriff's Office of Riverside County, the State Forestry fire stations in the district, and the individual farmers living in the nearby vicinity, of the time that Valve No. 21 would be opened. From experience in the past, they knew that those departments would soon be receiving numerous telephone calls inquiring as to what was taking place, and that those agencies would be sending out equipment unnecessarily.

Little Hazard Involved

It may seem strange, but the gas company officials maintain that there is but very little hazard in blowing the large amount of gas in the air, as was done in this instance. This is because the gas was released under a high pressure, which immediately sent it high in the air, and also because of the natural tendency for the gas to rise. The company's officials state that the main source of danger, in an operation of this nature, would come from a sudden downdraft which would force the gas, mixed with the air, down near the ground level, or from a plane flying through the contaminated area, where the exhaust from the plane might ignite the gaseous mixture.

Harry W. Gavin, General Foreman, under the direction of J. A. Millen, Division Manager of the Texas Pipe Line Division of the Southern Counties Gas Company of California at Indio, was in charge of operations. After Mr. Gavin had made a complete study of the project, he prepared a detailed schedule covering each step of the process required for completion. This schedule included the placing of radio equipment at strategic points along the line, as well as at the job proper. This was done in order to provide a means of communication from the job to the

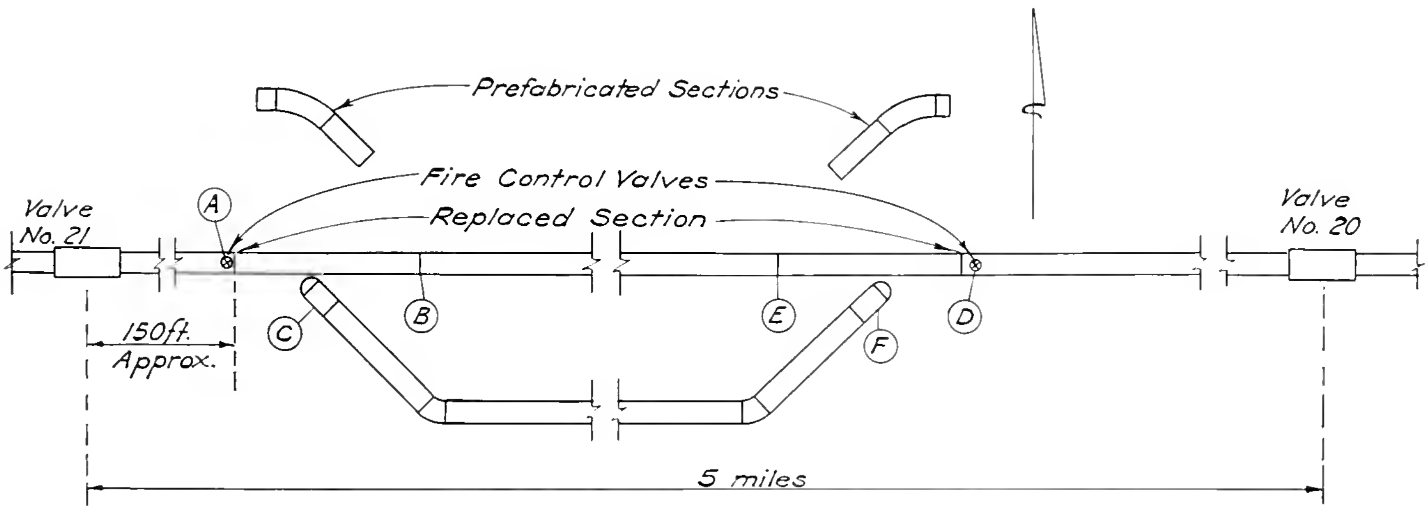


DIAGRAM SHOWING REARRANGEMENT OF CROSSING
SOUTHERN COUNTIES GAS CO.S' 30 INCH LINE
VIII-RIV-77-E

company's station at Olinda, from where, in turn, the progress of the work was transmitted to their coordinator in Los Angeles.

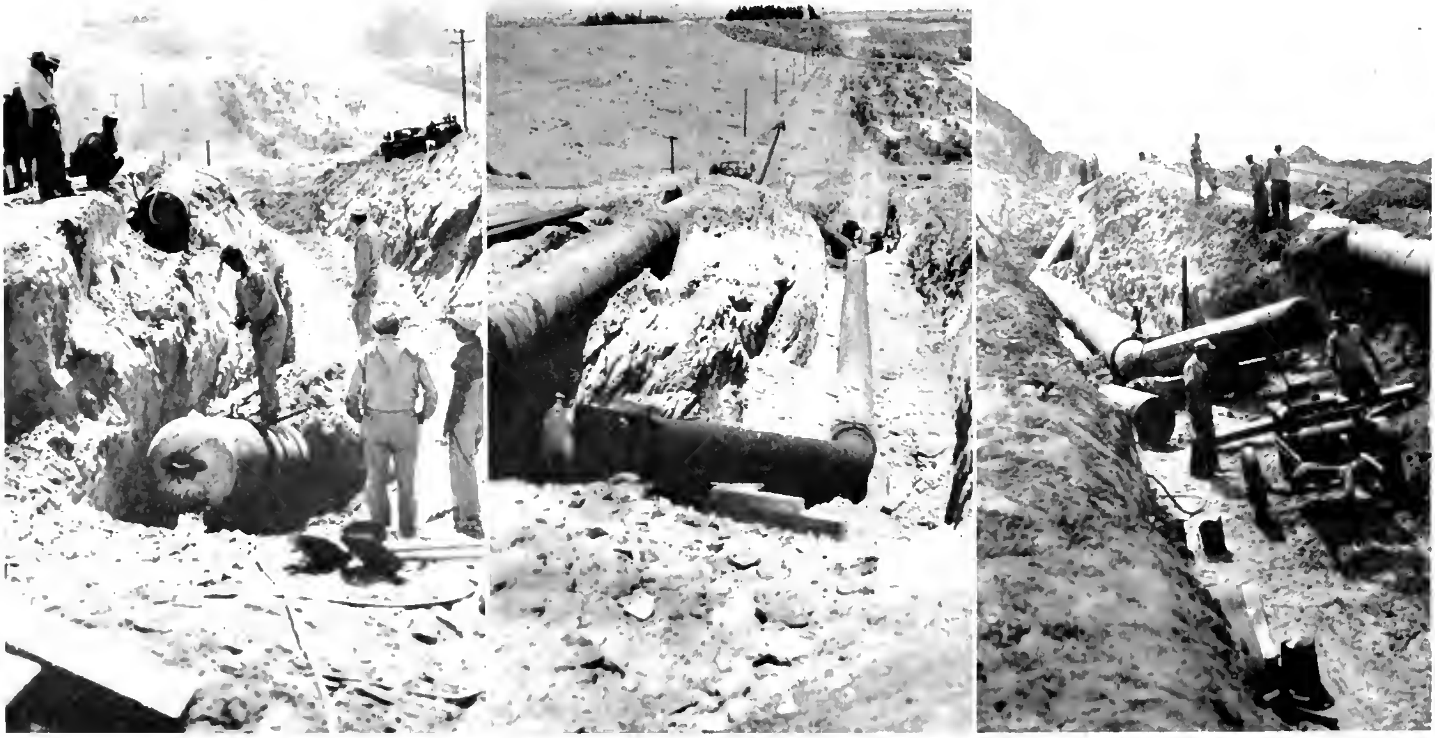
The coordinator's part was to see that gas was obtained from other fields, to take care of the supply lost during the shutdown, and to have this extra supply cut off when the line was again put back in service. Also included in the advanced planning, was the packing of the gas in the line up to a point considered sufficient to maintain service to the take-off lines between the job and Los Angeles.

June 4, 1949, 7 a.m. The "Big Blow" receding after 5½ million cubic feet of gas was blown to the atmosphere

"Sniffer" Detects Leaks

As a side line at this point, it is interesting to note that Mr. Gavin is the co-inventor of an instrument used by the gas companies to detect leaks in their lines. This instrument is known as the "sniffer," and has saved the company considerable time and money in the location of gas leaks.

The "sniffer" is a portable device that is towed behind either a truck or tractor. A subsoiler arrangement, a part of this device, makes it possible for it to "sniff" the backfill over the gas pipe at a depth of about 14 inches below the surface of the ground. Through a series of tubes, the air from the backfill is transmitted to a combustible gas indicator. Leakage areas are indicated by this combustible gas indicator, and that location is then marked on the ground. This "sniffer" is so sensitive



LEFT—June 4, 1949, 8.20 a.m. Upper section old line removed. Gas bag seal installed. Bull plug, lower section ready for removal, preparatory to connecting to existing main. CENTER—The new 30-inch gas main lowered and ready for connecting to the main line. Prado Dam left. RIGHT—June 1, 1949. New line installed on lower level ready to connect to existing 30-inch gas main. 36-inch pipe encasement shown

that it has been able to detect small leaks which had heretofore been undiscovered by ordinary methods of leakage detection.

Project Started in May

The Texas-to-California gas line is some 1,200 miles in length, and has a capacity of 305,000,000 cubic feet per day. Because the line is of such importance to the gas users of Southern California, it was found that it would not be possible to accomplish the rearrangement during the cold winter months, therefore, a time was chosen to do the work when there would be as little demand for domestic and commercial gas as possible. The project was started in the middle of May, during a period of warm weather. At that time, about 250,000,000 cubic feet of gas was going through the line each day.

The rearrangement of the gas line consisted of lowering the grade of the line from depths varying from 6 to 17 feet and encasing 119 feet of the 30-inch line in a 36-inch outer pipe. This was accomplished by laying the new pipe on the new grade parallel with the existing line, and 12 feet southerly. A total of 198 feet of the company's pipe was rearranged.

Details of Work

The preliminary work, consisting of laying approximately 152 feet of the pipe, and partially backfilling the trench was completed prior to the final day's work. The tie-in sections which consisted of a 31-degree ell with 3-foot and 15-foot legs at the east end, and an 18-degree ell with 4-foot and 12-foot legs at the west end were prefabricated and delivered to the job, ready to be put in place. The final day's work consisted of cutting the existing pipe at each end of the job, and welding the tie-in sections connecting the new line to the existing line, into place.

The work done was located between the company's Valves Nos. 20 and 21. These valves are approximately five miles apart, and it was necessary to blow the gas in the line between these valves into the air. The amount of gas blown into the air was approximately 5,620,000 cubic feet. Gas was blown out of the line until it was down to atmospheric pressure, then the blowoff stacks were closed so that no air could enter the line.

In Memoriam

HARRY W. DE HAVEN

The unexpected death on January 16th of Harry W. De Haven, Supervising Architectural Draftsman of the Division of Architecture, deprived the Department of Public Works of one of its most valued employees.

Born at Briarton, Pennsylvania, on October 23, 1891, Harry De Haven came to California with his family in 1904 and attended public schools in Chico and Dutch Flat before moving to Sacramento in 1905. He attended business college in Sacramento during 1906-07, worked on a surveying party for the Southern Pacific Company from 1907 to 1910, and then attended Vander Nailen College of Engineering for a year. In 1912 he accepted a position as junior draftsman with the old State Bureau of Architecture. During the World War years of 1917-18 he was employed by the Federal Government to do architectural work in St. Louis, Missouri.

Mr. De Haven joined the State Division of Architecture as a senior draftsman in 1920 and six years later was promoted to the post of Supervising Architectural Draftsman. For four years, 1922 to 1926, he was out of state service and was chief draftsman for Rudolph Herold, for many years a leading architect in Sacramento.

Mr. De Haven was a member of the Sacramento Lodge No. 40, Free and Accepted Masons, the Lodge of Perfection, Scottish Rites Bodies, and the American Institute of Architecture. He was a director and librarian of the Sierra Camera Club.

Mr. De Haven is survived by his widow, Eva C., his daughter, Mrs. Jean D. Griffin of Winters, Yolo County, his sister, Mrs. Ethel B. Cabaniss of Sacramento, his stepfather, Jess S. Hughs of Dutch Flat, Placer County, and a grandson, Jarrett Anson Griffin.

Fire Control Valves

Fire control valves were installed at points A and D on the accompanying diagram, prior to the shutdown, for the purpose of controlling the amount of fire in the cuts while cutting out the portions necessary in the old line, and welding in the new sections. A small trial cut was first made at point A to determine if conditions were right for cutting and welding. After doing this, adjustments were made as

Department Order

An order respecting incompatible employment of employees of the Department of Public Works has been issued by Director of Public Works C. H. Purcell in compliance with a 1949 act of the Legislature. The order which has been approved by the Personnel Board, as required by the statute, is published in full so that all employees of the Department of Public Works may familiarize themselves with it. The order follows:

Pursuant to provisions of Section 19251 of the Government Code, Chapter 474, Statutes of 1949, it is hereby determined and prescribed that as to employees of the Department of Public Works of the State of California, the activities hereinafter referred to, or any of them, will be considered inconsistent, incompatible, and in conflict with the duties of such employees as state officers and employees, and, therefore, will subject any employee engaging in such activities to disciplinary action as provided in the State Civil Service Act. The activities herein in this determination referred to shall include any employment, activity, enterprise, or other action which:

(a) Involves the use for private gain or advantage of state time, facilities, equipment and supplies; or the badge, uniform, prestige or influence of one's state office or employment or,

(b) Involves receipt or acceptance by the officer or employee of any money or other consideration from anyone other than the State for the performance of an act which the officer or employee, if not performing such act, would be required or expected to render in the regular course or hours of his state employment or as a part of his duties as a state officer or employee or,

(c) Involves the performance of an act in other than his capacity as a state officer or employee which act may later be subject directly or indirectly to the control, inspection, review, audit or enforcement by such officer or employee or the agency by which he is employed.

necessary at these fire valves, so that the job could proceed as planned.

While the pipe cutters were cutting the pipe, the drifting gas was burned. As soon as an end of pipe was cut, that end was immediately wrapped in wet canvas, and all fire extinguished. At two places, one on each end of the job, cuts had to be made in the old line so that sections of the pipe could be taken out.

When the first cut was made, the gas company field men nonchalantly stated in the log of the job, that there was "a lot of fire." You may be sure that when a gas man admits "a lot of fire," it looked to the ordinary layman like a blazing inferno.

Before the new sections of pipe were welded into place, all air had to be purged from them by filling with gas. This was done by means of temporary connections made from the live line ahead of Valve No. 21.

By the time that all welding was completed, the pressure in the line ahead of Valve No. 21, that is between the job and the Los Angeles area, was down to 400 pounds. It was estimated that the pressure could have dropped to 350 pounds, and still have maintained service.

The time consumed during the period that the first valve was closed at 6 a.m., the gas was released into the line, and the pressure equalized between Valves 20 and 21, was 11 hours and 58 minutes. The total elapsed time on the job, from the start to the release of the last radio car on the site was 12 hours and 5 minutes.

The Southern Counties Gas Company cooperated with the State in a fine manner in rearranging its facilities, and took full charge and responsibility for the work.

As stated before, the job was completely outlined, and care was taken to include even the minutest detail before construction operations commenced. A complete log of all operations was kept while the project was in progress, and is made a part of this article, so that an idea of the amount of work involved in relocating a utility facility of this nature, may be partially visualized.

The diagram illustrates the various cuts and welds made in the line.

In Memoriam

HARRY S. COMLY

Mr. Harry S. Comly, former District Engineer of the Division of Highways in Districts I and II, and District Maintenance Engineer in District XI, passed away in San Diego on December 1, 1949, at his home.

Mr. Comly was born on February 1, 1887, at Helena, Montana, and attended high school in San Diego. He was a veteran of World War I, serving in the Ordinance Department from 1918 to 1919.

He first started work with the Division of Highways on February 9, 1912, as a Chief of Party in District II. In 1914 he became Assistant District Engineer, which rating he held until 1924, when he became District Engineer. He continued as District Engineer until February 1, 1932, at which time he transferred to District I as District Engineer for about a year and one-half.

Following a year's leave of absence, Mr. Comly returned to state service with the Bridge Department as its southern representative at Los Angeles, and in September, 1935, became District Maintenance Engineer in District XI until October, 1948, when he retired because of ill health.

Mr. Comly was a 32d Degree Mason and a member of the Al Bahr Temple of the Shrine and the Scottish Rite bodies. He was also a member of the American Society of Civil Engineers, and had been extremely active in that organization. His wide experience and knowledge of highway work were of great benefit to all those with whom he came in contact.

His friends and fellow workers extend their sympathy to his sister, Miss Cora Hornbuckle.

In Memoriam

HARRY O. RAGAN

Eureka District of the Division of Highways mourns the death on December 10, last, of Harry O. Ragan, Associate Highway Engineer.

Mr. Ragan was born in Fillmore, Indiana, on January 5, 1886, and completed his schooling at Purdue University.

Harry came to the California Division of Highways from the Oregon Highway Department on the first day of February, 1922, as a Resident Engineer in District VI. In 1925 he was transferred to District VIII where he spent slightly more than 10 years as a Resident Engineer for that district. From 1936 to 1944 he was similarly engaged in District III at Marysville, transferring on April 1, 1944, to District I at Eureka.

Harry Ragan was no stranger to field work in engineering, having spent over a quarter of a century with the Division of Highways as a Resident Engineer on construction work. The total field work handled by Harry was of staggering proportions, he having probably handled as many individual contracts as any Resident Engineer working for the Division of Highways.

Since January 1, 1946, he had been assigned as Resident Engineer on work being performed in Trinity County by convict labor. Harry always worked hard at his job, and the many improvements on Route 20 through Trinity County will remain as testimony of his capacity and ability as an engineer.

Mr. Ragan is survived by his widow, Louise Ragan; his brother, Clarence Ragan; and two sisters, Edith Ragan and Nellie Ragan.

DANGER ZONES

When you drive, keep alert for danger zones at intersections, on curves and near hill crests. In these danger zones, keep to your own lane of traffic, reduce your speed and be prepared to stop in case of emergency.

ADJUST SPEED

Always adjust your driving speed to driving conditions, urges the California State Automobile Association. Slow down at night, or when the weather is rainy or foggy. Don't take chances.

No Small Job

Continued from page 18 . . .

Construction Speeded

On this project the resident engineer and the contractor recognized that all items of construction would have to be scheduled with the traffic in mind, and considerable time was spent in planning the work so that the speed of construction would not interfere with the heavy flow of traffic. The grade and alignment change between Gallitin Road and San Gabriel Boulevard necessitated two rather short road-mixed detours, one 400 feet long and the other 3,000 feet long. In order to keep the traffic moving the existing traffic lights were left in at Beverly Boulevard, San Gabriel Boulevard and Garvey Avenue as long as possible so that the interval between their removal and the installation of the new lights would be as short as possible.

Local Traffic Served

For the most part the property owners on the west side of the road were not seriously inconvenienced as their driveways remained unchanged. The condition on the east side of the road was very different as construction was carried on there for the full length of the project. During the grading, care was exercised to keep all driveways and crossroads open for the convenience of local traffic. In some places access driveways were bladed inside the right of way parallel with the new northbound lane. When the cement treated subgrade and Portland cement concrete pavement was started, openings were left in the headers as long as possible. During paving operations extra cement was added in front of driveways and at intersections for quick strength for early opening. It is believed that the time spent on planning the traffic handling during the construction period paid big dividends in convenience and time-saving for the traveling public and to the contractor by speeding up the job operations. Fred A. Read was resident engineer on this contract.

On the two recently completed contracts both the contractor's organizations and the resident engineers and their staffs are to be commended for the efficient manner in which public traffic was handled through construction on these two important contracts.

Another Contract Pending

As of the present time there is one more construction contract remaining to be advertised and let in order to complete throughout as a four-lane divided highway the 26.3 miles total length of the Lakewood-Rosemead highway between Long Beach and Pasadena. This last contract will be 1.4 miles in length extending from Garvey Avenue to Valley Boulevard. It will contain grade separation bridge structures to carry Route 168 under the Ramona Freeway location and under the Pacific Electric Railway double track line which is in the central division strip of the Ramona Freeway. The budget allocation in the 1949-50 fiscal year budget for this project is $1,159,000. It is anticipated that this construction contract will be advertised during the month of March or April, 1950. When this contract is completed, State Highway Route 168 will at long last be a modern four-lane divided highway throughout its entire length.

DON'T CROSS BARRIERS

Intermittent barriers to separate opposing lanes of traffic are seen along many of California's modernized highways. As a safety measure, the 1949 Legislature amended the Vehicle Code to prohibit driving across such an intermittent barrier except through an opening designed or intended for that purpose. Careful observance of this law, written for motorists' protection, is urged by the California State Automobile Association.

This view is looking northerly toward Garvey Avenue

Jimtown Bridge

Sonoma County's New F. A. S. Span Over Russian River Completed

By MARSHALL M. WALLACE, County Road Commissioner

THE OPENING of the Jimtown Bridge across the Russian River on November 4, 1949, marked the completion of the second major bridge project on the Federal Secondary System in Sonoma County.*

The project is located on the Healdsburg Road, FAS-788, which crosses Alexander Valley connecting U. S. 101 from a point north of Healdsburg with State Sign Route 28 east of Geyserville, at Jimtown. In connecting these two state highways, an appreciable saving in mileage is made to traffic traveling from the northeast section of the county toward Healdsburg and southerly to Santa Rosa, the Bay area, and to the resort areas along the Russian River and the Pacific Coast. This reduced mileage is also afforded to traffic originating in Southern Lake County and in the northwest end of the Napa Valley.

* Editor's Note: This is a Federal Aid County Road Project.

Farm-to-market Route

The road itself furnishes means of transporting produce to plants and distribution centers and is used extensively by the local farming interests in the operation of their farms, dairies, and other agricultural establishments. With the opening of this new bridge, the decrease in delays due to high water and the removal of the load limit should greatly reduce operational costs and add to the convenience of those using this road.

The grade of both bridge and highway have been raised to an elevation above the highest recorded high water; the traffic delays due to high water will be materially lessened by this construction. Though other portions of the route are still subject to high water, the lowest grades on the route which were within the limits of the construction have been eliminated. Also, the new structure will permit the unrestricted movement of legal loads over the route, and will eliminate the one-way traffic to which the trucks and busses were subjected in using the bridge.

Unusually Long Structure

The new bridge, 1,384 feet in length, replaces a bridge consisting of lightly designed truss spans and timber trestle approaches which were posted for less than legal loads and limited to one-way travel for trucks and busses. Also replaced by the new structure was a wooden pile trestle spanning an overflow channel on the northeast side of the river. In addition to the bridge, 0.22 mile of roadway was constructed to replace the southwest approach

Jimtown Bridge over Russian River looking north and showing truss spans and south approach

Another view of Jimtown Bridge from river bank

which was substandard as to width and alignment.

The structure consists of three 120-foot and two 84-foot steel pony truss spans with concrete deck, eight 45-foot concrete slab and girder spans and 19 concrete slab spans. The bridge has a 24-foot clear roadway between 1-foot, 8-inch widened curbs. Steel footing piles are used under the piers for the truss spans and for the slab and girder spans, while the flat slab spans are placed on steel piles with concrete extensions. The graded section of the approach is 32 feet wide, to which was applied a 24-foot bituminous macadam pavement.

Preliminary engineering work was performed under the direction of the county road department. Construction was done under contract by the C. B. Tuttle Company of Long Beach, at a cost of approximately $373,000. Construction engineering was performed by the Division of Highways, with G. C. Smith as Resident Engineer.

The right of way was acquired by the County of Sonoma and all cost of the acquisition was borne by the county. Construction costs were met by federal aid secondary funds provided by the Federal Aid Highway Act of 1944, and by state matching funds provided under the County Highway Aid Act of 1945.

Progress Report

Continued from page 23 . . .

concrete lining. A 10-inch clay sewer pipe was also constructed to serve a small section of state-owned property near the structure.

Backfilling Required

There was a considerable amount of backfilling to be done behind the bridge abutments and wingwalls. The contractor devised a very satisfactory method of compacting this material in the restricted spaces which were available.

A 15-inch pipe 9 feet long was poured full of concrete using steel scraps for aggregate so that weight of the tamping unit totaled about 3,500 pounds. This tamper was operated inside of an 18-inch steel pipe 21 feet long. Used in conjunction with a crane, the tamper was lifted and dropped inside of the larger pipe, compacting the fill material under blows of about 3 feet. The arrangement worked very satisfactorily and relative compactions of well over 95 percent were obtained even though the material was placed in 3-foot lifts.

The structure was designed and constructed by the Division of Highways, Bridge Department, under the direction of F. W. Panhorst, Bridge Engineer. Oberg Bros. Construction Company were general contractors on the work. The steel was fabricated by the Consolidated Western Steel Corporation. H. Ross Clinton was the Laboratory Inspector in charge of the steel fabrication inspection, and J. M. Peterson acted as Resident Engineer for the Bridge Department.

The approximate final cost of the project will be about $675,000. The accompanying photographs showing the steel construction were furnished by Consolidated Western Steel Company.

MARIN COUNTY INTERESTED

MARIN COUNTY PLANNING COMMISSION

California Highways and
Public Works
Sacramento, California

Gentlemen: Your official journal of the Division of Highways has been a constant source of information to this office.

We were particularly interested in the article "Service Town, U. S. A." in the September-October issue. This seemed a proof that proper highway design can add greatly to the welfare of any community.

Members of our commission and other public officials of Marin have expressed an interest in this article and we are wondering if you would be able to send to this office 12 copies of the September-October issue.

Sincerely yours,

Mary Robinson Gilkey
Planning Technician

HISTORY OF FEDERAL AID IN CALIFORNIA

Continued from page 2 . . .

had expended approximately $205,000,000 for the improvement of its State Highway System. During this same period of time California received $41,331,626.31 in federal aid apportionments and had completed improvement with federal aid on 2,500 miles of its Federal Aid Highway System which had now been expanded to 5,151 miles.

Depression Relief

The depression in the early '30's necessitated federal assistance to the states for the relief of the unemployed.

The first major relief legislation was the passage of the National Industrial Recovery Act on June 16, 1933. Under Section 204 of this act the sum of $400,000,000 was granted to the states for construction of public highways. Seven-eighths of this sum was apportioned among the states on the basis of the original Federal Aid Act formula; that is, on an area, population and post road mileage basis. The remaining one-eighth was apportioned in the ratio which the population in each state bore to the total population in the United States.

This federal grant was not required to be matched with state funds and could be expended to pay the entire cost of preliminary engineering and construction of projects on the Federal Aid Highway System and extensions thereto into and through municipalities and for the improvement of secondary or feeder roads to be agreed upon by the Federal Government and state highway departments. The money could also be utilized for eliminating hazards existing at railroad-highway grade crossings by the construction of separation structures and the installation of adequate protective devices.

Secondary Roads

The rules and regulations promulgated for the administering of the funds provided by this act defined secondary or feeder roads as farm-to-market roads, rural free delivery roads, and public school bus roads which are not a part of the Federal Aid Highway System. They could, however, be either part of the state highway systems or important local highways leading to shipping points or which would permit the coordination or extension of existing transportation facilities, including highways, rail, air and water.

Of the $400,000,000 appropriation, California received the sum of $15,607,354. Although the act did not require state matching funds, California elected to utilize some $5,500,000 of its own funds to assist in financing projects on the State Highway System. On completion of the work undertaken by authority of the National Industrial Recovery Act, California had expended a total of $21,162,682.64 composed of $11,834,630 for the improvement of projects on the Federal Aid Highway System, $5,017,901.27 for projects on extensions of the Federal Aid Highway System in municipalities and $4,310,151.37 for secondary or feeder road projects.

System of Numbering

The system of numbering projects in consecutive order as established by the original act of 1916 was continued for improvements on the Federal Aid Highway System with the prefix NRH, or NRM if located in a municipality. A new series of numbers was utilized for secondary or feeder projects prefixed with the letters NRS. From its apportionment of $15,607,354 California was reimbursed the sums of $7,936,500.46 for NRH projects, $4,202,360.10 for NRM projects, and $3,468,493.44 for NRS projects.

The increased tempo of highway construction, as brought about by the funds provided by the National Industrial Recovery Act and the favorable response by the state highway departments to this means of providing employment, prompted Congress to furnish additional funds for further needed highway improvements. This was accomplished under the Hayden-Cartwright Act of June 18, 1934, which authorized the appropriation of $200,000,000 to continue the work provided by Section 204 of the National Industrial Recovery Act.

Emergency Relief Act

This was followed less than a year later by passage of the Emergency Relief Appropriation Act which appropriated the sum of $800,000,000 for highways, roads, streets and grade-crossing elimination. California was apportioned $7,747,928 and $7,486,362 for highway and grade crossing projects, respectively. The funds provided by the Federal Government were primarily an unemployment relief appropriation and to insure the maximum employment possible, rules and regulations were provided requiring that labor employed on the projects must be certified by local state employment agencies and that labor would be restricted to eight hours per day and 130 hours per month.

With the aid of these funds California provided over 6,000,000 man-hours of direct employment, and constructed 316 miles of highway at a cost of $8,290,000 and 47 railroad-highway separation structures at a cost of $7,347,000.

Hayden-Cartwright Act

Aside from the unemployment relief appropriations, one of the outstanding features of the Hayden-Cartwright Act was the recognition of the importance of improvements of secondary or feeder roads. To assure that ample funds would be utilized for this type of improvement it specified that no less than 25 percent of the funds apportioned to the states be utilized for secondary or feeder road construction.

California's share of this $200,000,000 appropriation was $7,932,206. This was divided between expenditures on the Federal Aid System, in rural areas and in municipalities, and on secondary and feeder roads in the amounts of $3,610,886.30, $2,308,551.56 and $2,012,768.14, respectively.

Recognizing the dangers existing at railroad-highway grade crossings, California elected to utilize some $111,000 of its apportionment to reimburse the railroads for their expenses in connection with the installation of flashing light signals at 75 grade crossings throughout the State.

State-Federal Partnership

The proponents of this federal legislation recognized the importance of returning to the state matching basis

as rapidly as possible and to assure the continuance of this state-federal partnership in the construction of our vast network of federal aid highways, provided for the appropriation of the sum of $250,000,000 to be matched by the states for continuing improvements on the Federal Aid Highway System for the Fiscal Years 1936 and 1937. California's share for this two-year period amounted to $9,508,671.

Another feature of the Hayden-Cartwright Act was the provision that after June 30, 1935, federal aid for highway construction would be extended only to those states that use at least the amounts provided by existing state laws which are received from state motor vehicle registration fees, licenses, gasoline taxes and other special imposts on motor vehicle owners and operators for the construction and maintenance of highways. This measure has had the highly beneficial effect of preventing the diversion to other uses of state funds that by every test of equity and reason should be preserved for highway expenditure.

Surveys and Plans Money

This act also provided that a sum not to exceed 1½ percent of the amount apportioned for any year to any state may be used for surveys, plans, and engineering investigations of projects for future construction either on the Federal Aid Highway System or on secondary or feeder roads. This provision made possible the beginning of the state-wide highway planning surveys. California promptly availed itself of this provision of the federal law and organized a planning survey section.

One of the first important tasks of this new organization was the inventory of some 99,000 miles of California rural roads and the delineation of data obtained on a series of large scale county maps. The necessary field work was accomplished with WPA labor and was financed entirely with federal funds. These maps, showing culture, types of pavement and surface, traffic, school bus and R. F. D. roads, have been of immeasurable value to the Division of Highways and the U. S. Bureau of Public Roads as well as to the various counties of the State.

Important Function

Another important function undertaken by the California Division of Highways with funds provided for the state-wide highway planning survey has been the origin and destination surveys in and around our larger cities for the purpose of ascertaining the most desirable routings for future highway improvements.

The recent publicized report of the traffic survey of the Sacramento area and the forthcoming report of the San Francisco Bay metropolitan area are typical examples of the meritorious work being accomplished by the Division of Highways in cooperation with the Bureau of Public Roads under provision of the 1½ percent clause as contained in the Hayden-Cartwright Act.

Following the return to the matching and other basic provisions of the Federal Highway Act, the same provisions were contained in three succeeding acts authorizing additional sums to be apportioned for the Fiscal Years 1938 to 1943, inclusive. The additional amounts authorized for these years for improvements on the Federal Aid Highway System amounted to $665,000,000. These acts also authorized the total sum of $115,000,000 for the construction of secondary or feeder roads to be matched by the states and the total sum of $190,000,000 for the elimination of hazards at railroad-highway grade crossings.

Feeder Road Funds

The sums for secondary or feeder roads were apportioned to the states in the same manner as regular federal aid funds: Those for railroad-highway grade crossings on the basis of one-half population, one-fourth mileage of the Federal Aid Highway System, and one-fourth on railroad mileage. These grade crossing elimination funds did not require matching by the states. California's share of each of these three funds for the period 1938-43, inclusive, amounted to $25,763,287 for regular federal aid, $4,457,023 for secondary or feeder roads, and $7,147,361 for highway-railroad grade crossings.

New Provisions

In the last of the authorizing acts referred to, known as the Federal Highway Act of 1940, two significant new provisions appeared. A year before its passage the Bureau of Public Roads had been transferred by the President's Reorganization Plan No. 1 from the Department of Agriculture to the newly created Federal Works Agency. The old Bureau of Public Roads had now become the Public Roads Administration and Chief of the Bureau, Thos. H. MacDonald, had acquired the new title of Commissioner of Public Roads.

Under this new organization the Public Roads Administration was authorized by the Federal Highway Act of 1940 to investigate, in cooperation with and at the request of state highway departments, the location and development of flight strips adjacent to public highways for the landing and taking off of aircraft. This was the first recognition in federal aid highway legislation of a possible connection between the highways and the ground facilities for aircraft.

National Defense

The other significant departure forecast, a year and three months before the United States entrance into World War II, the greater responsibility the Federal Government would assume in meeting the cost of highway improvement to further our national defense. On the request of the Secretaries of War and Navy or other authorized national defense agencies, federal aid funds previously authorized were made eligible to reimburse the states for the entire engineering costs of surveys, plans, specifications, estimates and supervision of construction of projects which would result in the improvement of highways strategically important to our national defense.

World War II Legislation

With the United States on the threshold of World War II, Congress passed the Defense Highway Act of 1941 which became law on November 19, 1941. This act strongly supplemented the foregoing preparatory measures first introduced in the Federal Highway Act of 1940. The sum of $150,000,000, which was later supplemented to $260,000,000 and then to

$290,000,000, was authorized to be appropriated and made available to any state without regard to a formula basis, for reimbursing such a state for all or any part of the cost of construction and acquisition of rights of way for the improvement of access roads to military and naval reservations, defense industrial sites, or to sources of strategic raw materials.

The act added a further authorization for the appropriation of two sums of $25,000,000 each to reimburse the states for their expenses in connection with the correction of critical deficiencies of the strategic network of highways. This strategic network of highways had been previously designated on a map approved by the Secretary of War on May 15, 1941.

Matching Basis

One of the two $25,000,000 authorizations was apportioned in accordance with the regular federal aid formula and was to be matched by the states on the basis of 75 percent federal to 25 percent state. California received $997,474. The 75 percent federal ratio was increased in the so-called public lands states. The federal-state ratio in California was 79.13 percent federal to 20.87 percent state. The second $25,000,000 was allocated by the Federal Works Administrator without regard to apportionment formulas to the states to supplement other available federal funds for the purpose of providing 100 percent federal reimbursement for improvements on the strategic highways. Of this latter sum California received $1,416,133.

Of the $290,000,000 appropriation for access roads California received the sum of $35,199,000.

Terminal Island Project

One of the largest access roads improved by the Division of Highways from funds provided by this act was the construction of the roadway approaches to the Cerritos Channel Bridge connecting the Cities of Long Beach and Los Angeles to the Roosevelt Naval Base on Terminal Island. The sum of $6,837,900 was set aside by the Federal Government to defray the State's expenses in connection with the improvement of this road.

The same act also authorized the Commissioner of Public Roads to consider claims of the states or their subdivisions for reimbursement of the cost of repair of roads damaged by the Army or Navy and present approved claims to Congress for payment out of appropriations to be made therefor.

Claims for Damaged Roads

Claims totaling $1,930,000 for repaying California for damaged state highways and $450,000 for reimbursing the California cities and counties for their expenses in repairing streets and roads have either been paid or recommended for payment to the State or its affected political subdivisions.

The act authorized the appropriation of $10,000,000 for the acquisition of rights of way and the cost of constructing flight strips adjacent to public highways. The California Division of Highways, acting upon the request of the Public Roads Administration and the Army Air Corps, constructed five such flight strips in this State at a cost of $2,245,325.

Traffic Congestion Problems

The ever increasing traffic problem in our metropolitan areas greatly stimulated by the Nation's defense activities considerably concerned the highway engineers. In order to assist the various states in financing the costs of surveys and studies for a possible solution of this problem and as an incentive for continuing work of this nature, the act authorized the sum of $10,000,000 to be apportioned among the states on the regular federal aid formula to be matched with state funds to be used for advance engineering surveys and plans for future development of the strategic network of highways and by-passes around and extensions into and through municipalities and metropolitan areas.

Federal funds in the amount of $398,990 were apportioned to California for this purpose. Surveys undertaken by the Division of Highways under authority of this provision of the act included such prominent freeways as the Hollywood, Santa Ana, and Sepulveda Freeways in the Los Angeles area and the Bay Shore and East Shore Freeways in the San Francisco-Oakland metropolitan area and the North Sacramento Freeway near our State's capital.

War Curtails Construction

With the advent of the United States into World War II, critical shortages of manpower and materials necessitated the restriction of highway work to projects strictly essential to the war effort. These restrictions seriously curtailed federal aid improvements. Since substantial portions of the appropriations authorized remained unexpendable for construction purposes, Congress by act approved on July 13, 1943, authorized the use of a portion of these funds for immediate surveys and preparation of plans for future highway construction. Accordingly, California was permitted to use a sum not to exceed $2,053,972 composed of regular federal aid, secondary and grade crossing funds for such cooperative preliminary engineering work.

A preliminary engineering program was compiled and submitted to the Public Roads Administration for approval involving 64 projects on the State Highway System designed to utilize federal funds in a total amount of $675,300. Following the cessation of hostilities many of these projects were included in federal aid construction programs resulting in the completion of these needed highway improvements shortly thereafter.

Express Highways

The 1943 act directed the Commissioner of Public Roads to make a survey of the need for a system of express highways throughout the United States. The result of this survey is published in a report submitted to the President and Congress entitled "Interregional Highways" and is the forerunner of the future discussed Interstate Highway System.

This act also broadened previous federal aid legislation regarding war-damaged roads and bridges to make federal financial assistance applicable to roads and highways damaged by the action of contractors of the Army and Navy engaged in work in connection with the prosecution of the war or for the national defense.

Prior to the cessation of hostilities and as a basis for postwar construction the Federal Aid Highway Act of 1944 became law on December 20, 1944.

Postwar Appropriation

This act authorized a $1,500,000,000 appropriation for a three-year postwar period to be made available to the states at the rate of $500,000,000 a year as soon as the President and Congress determined that the war emergency had been relieved to an extent that would justify proceeding with highway construction. (By concurrent resolution passed by the House of Representatives on September 27, 1945, and by the Senate on October 2, 1945, the first postwar fiscal year was established as ending June 30, 1946.)

Of the $500,000,000 yearly appropriation, $225,000,000 was to be utilized for improvements on the Federal Aid Highway System, $150,000,000 for secondary or feeder roads, and $125,000,000 for projects on the Federal Aid System in urban areas. An urban area was defined as an area including and adjacent to a municipality or other urban place of 5,000 or more inhabitants according to the latest available census.

Urban Areas Established

The boundaries of urban areas were to be fixed by the state highway departments subject to the approval of the Public Roads Administration. The California Division of Highways established 64 urban areas in this State which included 110 cities and the Belvedere township in Los Angeles County having populations of 5,000 or more. These urban areas were approved by the Public Roads Administration on October 16, 1945.

The federal funds authorized for these three classes of roads were apportioned to the states in the following manner: For improvements on the Federal Aid Highway System the formula established by the Federal Aid Road Act of 1916 was utilized, giving equal weight to the area, total population, and mileage of post roads in the State. The appropriation for secondary or feeder roads was apportioned to the states on the basis of one-third in the ratio to which the area of each state bears to the total area of all states, one-third in the ratio which the rural population in each state bears to the total rural population of all states as shown by the federal census of 1940, and one-third in the ratio which the mileage of rural delivery and star routes in each state bears to the total mileage of rural delivery and star routes in all the states.

In the apportionment of funds for improvements of the Federal Aid System in urban areas the factor of population of urban places of 5,000 or more was used exclusively.

Right of Way Money

This act permitted the utilization of federal funds to assist in defraying a state's expense in connection with the acquisition of rights of way up to one-third of such cost. The act also provided that up to 10 percent of the sums apportioned to the states could be used to defray the entire expense in connection with the elimination of hazards of railroad-highway crossings. On such railroad-highway projects the act recognized that certain benefits would accrue to the railroads affected and as a consequence provided that such railroads should contribute not to exceed 10 percent of the total cost of the railroad-highway crossing elimination projects when such benefits were so established.

Interstate Highways

Perhaps one of the most farsighted provisions of the act was the creation of a national system of interstate highways not exceeding 40,000 miles in total extent. This system of interstate highways was designed to connect by roads as direct as practicable the principal metropolitan areas, cities, and industrial centers to serve the national defense and to connect at suitable border points with routes of continental importance in the Dominion of Canada and the Republic of Mexico.

The system as selected and approved in California included 1,938 miles.

Airport Requirements

The rapid development and expansion of airports and their possible effect on the adjacent highways required joint action and study by the airport authorities and highway and local road officials. The 1944 act provides for such joint study by including a provision requiring that no federal funds apportioned by any of the Federal Aid Highway Acts may be utilized for the relocation or reconstruction of any highway giving access to an airport until the state highway department and the Public Roads Administration have concurred with the officials in charge of the airport that the location of the airport or its proposed development and the consequent reconstruction or relocation of the highway are in the public interest.

Uniform Signs

The need for standardizing informational, regulatory, and warning signs, curb and pavement or other markings, and traffic signals among the various states of the Union has been apparent and the Federal Highway Act of 1944 provides that on any highway or street thereafter constructed with federal aid, the location, form, and character of such signs, markings, or traffic signals shall be subject to the approval of the State Highway Department with the concurrence of the Public Roads Administration.

California's total apportionment for the three-year period for each of the three classes of projects as provided by the Federal Aid Highway Act of 1944 is as follows:

Federal Aid Highway System	$26,934,159
Extension of federal aid highways in urban areas	24,262,568
Secondary or feeder road projects	15,416,318

California Fortunate

California was most fortunate in having sufficient state highway construction funds available after taking into account the anticipated apportionments of federal funds for federal aid highway and urban improvements to submit programs for federal aid and urban highway construction of sufficient magnitude which would enable the State to request federal participation in construction work undertaken by contract only without resorting to the inclusion of preliminary engineering and right of way costs. Eighty-seven and one-half percent of the $15,416,318, or $13,489,279, apportioned to California for the improvement of secondary or feeder roads was reapportioned to the various counties of this State utilizing the area, rural population, and post road mileage formula by the County Highway Aid Act of 1945. This State Aid Act appropriated $12,000,000 of state funds to be used to

march the 13½ million dollars of federal funds. The state administration of the secondary funds provided by the Federal Aid Highway Act of 1944 and the County Highway Aid Act of 1945 was handled by the newly created Federal Secondary Roads Department of the Division of Highways.

Act of 1948

To continue the work authorized by the Federal Aid Highway Act of 1944 and to provide federal assistance in financing the growing demands for more adequate highways, Congress passed the Federal Aid Highway Act of 1948 on June 29, 1948.

This act authorizes the appropriation of $450,000,000 a year for a two-year period. California's total share of these two authorizations is $39,693,601. This sum was divided by federal statute as follows: For improvement on the Federal Aid System, $16,063,091; for secondary or feeder road construction, $9,197,926 and for construction on the Federal Aid System in urban areas, $14,432,584.

In keeping with current practice and state laws, California included these sums in its State Highway Fund budgets for the fiscal years ending June 30, 1950, and June 30, 1951, as anticipated revenue. Programs designed to obligate the entire amounts apportioned for federal aid and urban construction and nearly one-half of the secondary apportionments have been approved by the Public Roads Administration.

County Highway Act

According to the principles established by the County Highway Aid Act of 1945, the California Legislature by Senate Concurrent Resolution No. 62, passed in May and June of 1949, stipulated that at least 87½ of the secondary funds apportioned to California by the Federal Aid Highway Act of 1948, or $8,048,185, should be apportioned to the counties in the same manner as was done under the County Highway Aid Act of 1945.

No state general funds were appropriated by the Legislature to match these federal funds. It was anticipated that the counties would have sufficient funds due to increased apportionments of Highway Users Tax funds under the Collier-Burns Highway Act of 1947 to take advantage of this federal money.

On July 1, 1949, the Public Roads Administration was transferred from the Federal Works Agency to the General Services Administration and on August 20, 1949, became the Bureau of Public Roads under the U. S. Department of Commerce.

Most Recent Step

The Federal Aid Highway Act of 1948 is the most recent step in over 30 years of federal assistance in the planning, financing and construction of our highways. During this period, California has received a total of over $281,000,000 of federal aid which has materially helped in financing the construction of one of the best highway systems in the country.

Since the Federal Aid Highway Act of 1948 provides federal aid only to the fiscal year ending June 30, 1951, appropriate action is being taken by the American Association of State Highway Officials and numerous other organizations to bring before the Congress of the United States their request for a continuing appropriation of federal funds for highway improvement.

Statement of Policy

Acting on recommendations of the Committee on Legislation and Administrative Policy and the Executive Committee, the chief administrative officers of the American Association of State Highway Officials on November 21, 1949, approved the following national statement of policy concerning future federal aid:

1. Four authorizations of federal aid funds on an annual basis.

System	Proposed	(1948 Act)
Interstate	$210,000,000	($000,000,000)
Primary	$270,000,000	($202,500,000)
Secondary	$180,000,000	($135,000,000)
Urban	$150,000,000	($112,500,000)
Total	$810,000,000	($450,000,000)

2. That the federal aid primary, secondary and urban allocations be distributed among the states in accordance with the regular formulas and matching basis as provided in the Federal Aid Highway Acts of 1944 and 1948; that not more than 25 percent of the amount apportioned to each state for the primary and secondary systems may be switched from one system to the other provided the state highway department makes such request and it is approved by the Commissioner of Public Roads as being in the public interest.

3. That the interstate funds be apportioned on the basis of population of the states and that no state receive less than three-quarters of 1 percent; that the matching ratio be 75 percent federal funds and 25 percent state funds.

4. That these interstate funds may be utilized at the option of any given state, to apply on the principal of general obligation bonds on toll-free facilities that may be used by such state for the purpose of expediting the improvement of the interstate system of roads.

5. That the provision in the Federal Aid Highway Act requiring the withholding of federal aid from any state failing to properly maintain a federal aid project be amended so that in the case of secondary and urban projects where a county or city has accepted responsibility for maintenance, future federal aid funds will be withheld from the county or city failing to maintain rather than from the state as a whole.

6. That a section be added to the proposed Federal Aid Highway Act authorizing an amount not to exceed $10,000,000 to be utilized by the Bureau of Public Roads, under specific emergency conditions, for the purpose of cooperating with the state highway departments in highway disaster relief on an area basis when an emergency has been declared by a governor of a state and concurred in by the Commissioner of Public Roads, without limitation as to systems, and on a 50-50 matching basis.

7. That a special appropriation of $100,000,000 be authorized for the purpose of advancing funds to the state highway departments for the acquisition of rights of way to be repaid over an extended period of years.

8. That the present one-third limitation on federal aid for right of way purposes be increased to 50 percent.

Population Increase Benefits

Since population plays such an important role in the federal aid apportionment formulas, California, with its high rate of increase since the last federal census, would materially benefit in any new appropriation predicated on 1950 census figures.

Based on an estimated 1950 population, California's yearly share of these recommended authorizations is roughly estimated as follows:

Interstate System	$13,800,000
Primary Federal Aid System	12,400,000
Secondary System	6,800,000
Urban System	13,100,000
Total	$46,100,000

INDEX TO CALIFORNIA HIGHWAYS AND PUBLIC WORKS

January 1 to December 31, 1949

AUTHOR'S INDEX

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director

HIGHWAY COMMISSION

C. H. PURCELL . . . . Chairman
HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
FRED J. GRUMM . . Deputy State Highway Engineer
J. G. STANDLEY . . Assistant State Highway Engineer
R. M. GILLIS . . . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
T. E. STANTON . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
C. E. WAITE . . . . Engineer of Design
EARL WITHYCOMBE . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

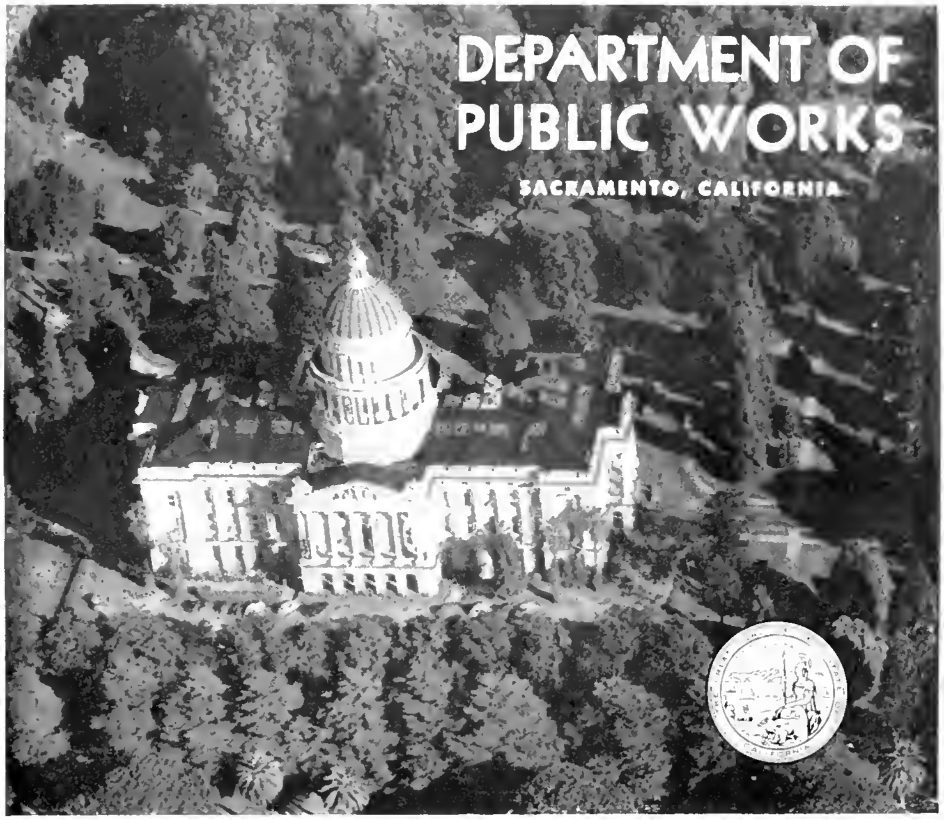
FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

District VII

P. O. HARDING . . Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
F. W. HASELWOOD . . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
E. Q. SULLIVAN . . . District VIII, San Bernardino
S. W. LOWDEN . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

C. R. MONTGOMERY . . . . Chief
ROBERT E. REED . . . . Attorney
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
P. H. VAN ETTEN
Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
W. K. DANIELS . Assistant State Architect (Administrative)
P. T. POAGE Assistant State Architect (Design and Planning)
D. C. WILLETT . . . . Chief Construction Engineer

Headquarters

A. F. DUDMAN . . . Principal Architectural Designer
C. L. IVERSON . Supervising Architectural Draftsman
CARLETON PIERSON . . Supervising Specification Writer
FRANK A. JOHNSON . . Principal Structural Engineer
C. A. HENDERLONG
Principal Mechanical and Electrical Engineer
WADE HALSTEAD . . . . . . Supervising Estimator

SCHOOLS

W. H. PETERSEN Principal Structural Engineer, Sacramento
H. W. BOLIN . Principal Structural Engineer, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 59813 1 50 24M

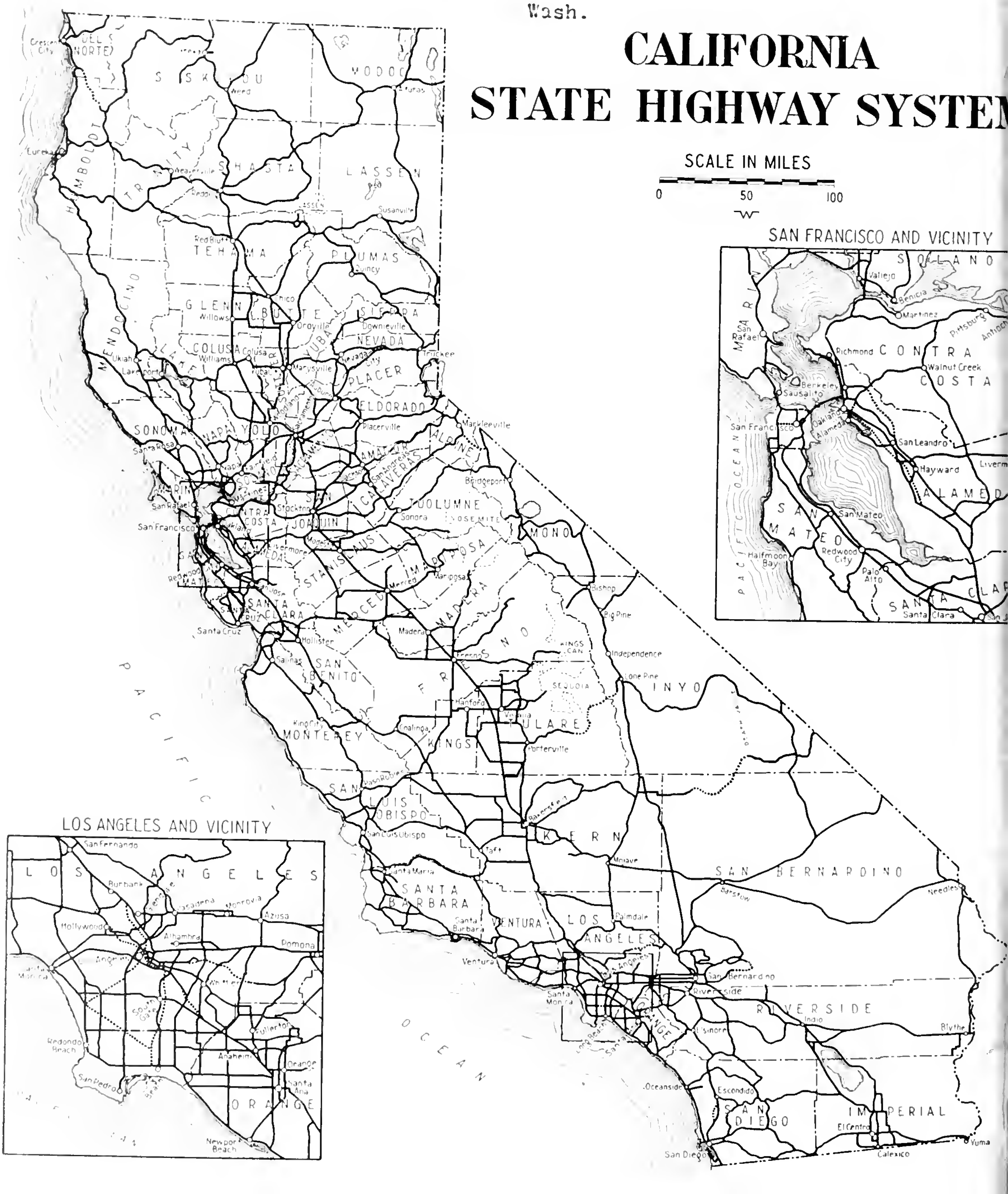
California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

Seattle Public Library,
Seattle,
Wash.

CALIFORNIA STATE HIGHWAY SYSTEM



CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 March-April Nos. 3, 4

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

The Concluding Article of a Series by G. A. Tilton, Jr., Supervising Highway Engineer, "Prison Labor—Story of Highway Road Camps in the State of California," Will Appear in the May-June Issue of This Magazine.

Roseville Underpass Opened on April 1 at Cost of $1,485,000

By G. A. GREENE, Associate Highway Engineer

The Roseville underpass was opened with appropriate local ceremonies on April 1st. It is another important step in the relief of bottlenecks and congested urban areas along Route US 99E. This project, having a total cost of about $1,485,000, is in the heart of the City of Roseville, Placer County, running from Vernon and Grant streets through the center of town and two miles north of town toward Marysville.

Southern Pacific freight yards in which freight trains are made up for the trip over the mountains going east, divide the City of Roseville. In the past these yards formed an effective barrier to highway traffic. Owing to the very large number of switching operations in progress in the yards, the grade crossing at Lincoln Street was customarily blocked for long periods of time and the delays to highway traffic were very severe. The fact that there are 17 railroad tracks at this location made the construction operations difficult and separation of the crossing required a project of major magnitude.

BLANDLY OBLIVIOUS

"Blessed be the bridge that carries me over"
Said the sage of ages past,
When bridges were weak and crudely built
And each crossing might be the last.
They blessed the road that guided them:
Our forbears plodding along;
Though wearied by the rough, faint trail,
Their hearts beat a grateful song.
The bridge today is strong and sure,
A thing of beauty and grace,
Leaping safely o'er road and river,
Gladly bearing one on apace.
The road today is marked and smooth,
Delighting the traveler's eye,
Like the rug of a giant magi,
Through the valleys and mountains high.
But who today gives time or thought
As he rushes from dawn to dawn,
To contemplate the blessings of
These fruits of brain and brawn

S. R. OFFUTT
District VII, Division
of Highways

Dedicated to Spencer V. Cortelyou, Assistant State Highway Engineer, Retired

Underpass Has Four Lanes

The south end of the work begins at the intersection of Vernon and Grant Streets. Traffic will be temporarily routed around one block to come on to the four-lane divided section of the underpass at Washington Street. The underpass itself, which will be a continuation of Washington Street, provides four lanes of divided highway underneath the railroad yards. The crossing at Washington Street is parallel to and one block south of the old grade crossing on Lincoln Street.

The portion of the structure under the railroad tracks is 360 feet long, the railroad being carried on steel rolled beams. Coming out of the underpass,

Close-up view of Roseville underpass which carries traffic under railroad tracks to and from U. S. 40 and U. S. 99E

Widening of U. S. 99E gives sight distance at Andora subway one mile north of Roseville, previously a traffic hazard

the highway continues in a northeasterly direction on Washington Street which was rebuilt and widened to provide four lanes with a center dividing strip. About 2,000 feet from the subway the four lanes are decreased to two lanes which extend to the end of the project about two miles north of town.

Andora Subway Approaches

Another major feature of the new alignment is the elimination of the dangerous curves adjacent to the Andora Subway about one mile north of Roseville. The old road approached this narrow subway with a sharp curve on each end of the underpass. The new alignment making a considerably wider swing on each end, approaches the underpass on a tangent and by eliminating the dangerous curves, gives the traffic a straight approach to the opening.

The underpass itself has a reinforced concrete deck on steel beams. The spans are 31 feet and 39 feet, supported on reinforced concrete abutments with a steel center bent between the two lanes of traffic. This provides two 24-foot roadways in each direction with a six-foot center dividing strip. A seven-foot elevated sidewalk is provided along the west side.

Owing to the length of the structure and its tunnel-like aspect, it is necessary that continuous lighting be provided for both pedestrian and vehicular traffic. It was also necessary to provide a pump house with sump pumps to remove the runoff which will accumulate in the depressed portion.

Problem of Railroad Tracks

The major problem of constructing the underpass beneath 17 active railroad tracks without disrupting the railroad's use of its facilities was accomplished by doing the construction in three separate operations. The railroad tracks were moved sufficiently to provide working room for approximately one-third of the structure. After this portion was completed, the tracks were moved back to their original position except that they now are supported by the new structure. After three such shifts and three stages of construction of the underpass, all of the railroad tracks were replaced approximately in their original locations. All of the track work, moving, and reconstruction of the railroad appurtenances was done by the Southern Pacific Company's forces.

In addition to the underpass under the railroad, two overcrossings were provided over the depressed section to carry Vernon and Atlantic Streets across the highway. Both of these structures are of reinforced concrete slab construction with center bents in the dividing strip.

Concrete Pavement

The concrete portions of the pavement are uniform thickness eight-inch slabs placed on four inches of cement treated base which over-laid a base course of selected material. The plant-mixed portions of the road consist of

. . . Continued on page 8

←Aerial view of the improvement included in the Roseville Underpass project. The old route entered from Sacramento on Vernon Street at the lower left, thence to Lincoln Street and a left turn across the railroad tracks near the end of the yard at right center. The old route then followed the railroad to the Andora Underpass in the center distance where, with two sharp curves it ducked through under the railroad.

The new layout envisions a connection to the new freeway from Sacramento in the center foreground. For the present, traffic going north will make a right turn off Vernon Street and then two left turns to lead into the underpass and under the railroad yard.

Through town the highway is divided, reducing to two lanes at the north edge of town. The alinement is improved at the Andora Underpass, eliminating the hazardous curves. The new line joins the old in the right distance.

Traffic Striping

New Idea for Laying Out Highway Traffic Stripes

By DON WIEMAN, Highway Superintendent

UPPER LEFT—Transit, set up near the end of existing center stripe, ready to control spotting adjacent unpainted section. LOWER LEFT—Spotting device in operating position, showing the actuating mechanism coupled to the control trigger of the spray gun

THE PRACTICE of painting lines and other markings on highway surfaces, generally referred to as traffic striping, is probably the greatest single contribution in many years to highway safety. The placing of this traffic stripe, however, is not only one of the most hazardous of highway maintenance operations but is a costly process as well.

In studying the problem of lowering costs and reducing hazards it is at once apparent that the materials used are standardized and their costs are not very flexible. Neither is there much allowable variation in the actual applying of the paint which is done by means of spray guns mounted on a lightweight striping machine. This machine is pushed ahead of a truck which carries the supply of paint and an air compressor. Both paint and compressed air are delivered to the striping machine through hoses. The operator of the striping machine steers it along the established course while the spray guns apply the paint either as dashed or solid, double or single lines.

Hazardous Job

The repainting of existing stripe is relatively simple where there is enough of the old paint remaining on the pavement to serve as a guide for the striping machine. The possible saving in cost and the greatest possible reduction of hazard lies primarily in the work preliminary to painting new stripes. This has always been an awkward and inefficient procedure. The practice has been that of "pig tracking" which consisted of painting spots by hand along a rope stretched tightly between previously established points—these spots or "pig tracks" being used as a guide for the striping machine. This method was slow and particularly hazardous to those so engaged because of their exposure to vehicles travelling along the highway.

. . . Continued on page 52

UPPER RIGHT—The last spot of a run. Equipment remained in this position to serve as a back sight for next transit setting
LOWER RIGHT—Line of spots produced by spotting device

Expressway

Thirteen Miles of Limited Freeway Completed on U. S. 40 During 1949

By M. C. FOSGATE, District Construction Engineer

During 1949, District X of the State Division of Highways opened to traffic as an expressway (limited freeway) a total of 12.95 miles of four-lane divided highway on U. S. 40, extending from Vacaville, by-passing Fairfield, through the American Canyon to a connection with the existing four-lane road near the Napa county line.

All two-lane road is eliminated between Sacramento and the Bay area with the exception of that portion which lies between Ledgewood Creek and Cordelia, a distance of 5.24 miles, and a short section betwene Ulatis Creek and Alamo Creek, 1.4 miles. It is hoped both of these remaining sections will be under contract before July 1st of this year.

The section between Ulatis Creek and Alamo Creek will require the construction of a separation structure over a county road and the Southern Pacific Railroad branch leading into Vacaville. A railroad underpass structure is also included in the plans for the Ledgewood-Cordelia unit.

American Canyon Section

The most important section of this construction, as far as the traveling public is concerned, is probably that section known as the American Canyon, which, when originally opened to traffic in 1936, eliminated the old winding road through Vallejo up the Napa Valley to the Napa Wye, then winding back through the Jamison Canyon to the Cordelia Wye, now the easterly terminus for the American Canyon section of U. S. 40.

When the American Canyon section was first opened to travel, it was considered one of the outstanding revisions of highway routing in Northern California. However, as traffic volumes increased, along with rising vehicle speeds and continual expansion of truck transportation, the long grades and curves made passing extremely hazardous. By 1940 traffic conditions were such that four lanes were necessary, but the war caused postponement of any construction. In 1942 the department widened a section from near the Napa county line on the east through Rindler Creek and over the two major summits in the American Canyon to a four-lane undivided highway. This revision eliminated the high, dangerous, wooden structure across Rindler Creek by filling from slides on the two summits. This was all the work that it was possible to do during the war years for relief to traffic on this section.

The present four-lane improvement has made it possible for the faster-moving vehicles to pass the trucks throughout the canyon, and this section is no longer a hazard or a hindrance to fast-moving vehicles.

Smoothest Pavement

The added lanes on the section from Vacaville to the commencement of the Fairfield By-pass were placed to the north of the present traveled way, utilizing the present traveled way for eastbound traffic. This is also true in the American Canyon. The section from 3.5 miles east of Fairfield to Ledgewood Creek, a distance of 4.7 miles, is on new alignment, consisting of two 24-foot concrete roadways.

The section of U. S. 40 past Fairfield was measured for roughness by a machine perfected at the University of California and found to be the smoothest pavement so far measured.

Heavy Grading

Due to the heavy grading necessary on the Vacaville end as well as through the American Canyon, the dividing strip between the two traveled ways varied in width, and in some cases is as narrow as 16 feet, which is considered

View on the Fairfield by-pass section of U. S. 40, showing the westerly approach to Fairfield

Section of Fairfield by-pass with the eastbound lane to the right near the east entrance to Fairfield

the least that is desirable on a divided highway. Where these narrow medians exist, it is necessary that the difference in elevation of the two roadways be held to a minimum. In such locations, particularly around curves, guard railing was considered necessary to prevent cars from going over the grade and into opposing traffic. This guard rail also partially deflects headlight glare at night. A total of 13,000 feet of guard rail was placed on these three projects. To delineate the roadways in locations where guard railing was not used, reflectorized sight posts were placed. At night these reflectorized sight posts give the effect of illumination, and it is believed that these three projects are delineated as well as any project not using artificial lighting.

Many Cuts

The three projects consist of five-sack-per-yard concrete pavement, eight inches thick, each roadway 24 feet wide with plant-mixed borders, the remainder of the shoulders outside of the borders being covered with a Class "C" seal coat. Under the concrete slabs is a four-inch subbase. All cuts, of which there were many, were sloped 1½:1, which should preclude any heavy sliding of material in a locality where the formation tends to slip at the least provocation.

There was but one heavy slide on these projects and it included the removal of only 20,000 cubic yards. There was one cut on this project 200 feet high. This cut was about half out when a spring developed at the bottom of a layer of sandstone. This spring was not extensive; however, a considerable area of the bank was saturated. To stabilize the saturated area, willow sticks were planted, and at the present time are growing rapidly, apparently having accomplished their purpose as no slides or slipouts have developed in this area.

Drainage Problems

There was one major spring area in the American Canyon where the material was saturated by flows of water

View on Vacaville project facing east, showing the new lane on the left at the intersection of the old state highway routing now known as the Cherry Glen Road

View facing west with new lane showing on the right about 2.5 miles west of Vacaville

from the hills to the north. This condition had previously been encountered in the original construction of the American Canyon section and considerable effort was expended in draining the area under the original grading contract. However, approximately two years after this section was under traffic the designed system of drainage became plugged, the highway fill collapsed and moved out, necessitating detouring traffic around the area.

A study was made by drilling test wells to determine the depth to embedded shale and the water stratum. The fill was then removed and the ground stripped to the embedded shale area. Drainage systems were installed and drain rock was placed. The fill was then reconstructed and the traffic was rerouted over the original alignment.

The presence of the spring was the reason for placing the added lane over this section on the west side of the existing traveled way, thus placing the new lane into the hill and avoiding overloading the spring section. It was necessary to remove the soil under the new road to a depth of 45 feet, where the embedded shale was again found, and a new drainage system installed. It was planned to jack pipes through the existing highway. It was, however, found that the fill underlying this highway was not of sufficient stability to allow the jacking of the pipes, and it was necessary to cut this road in two places in order to drain the water encountered under the new construction.

Major Contract Items

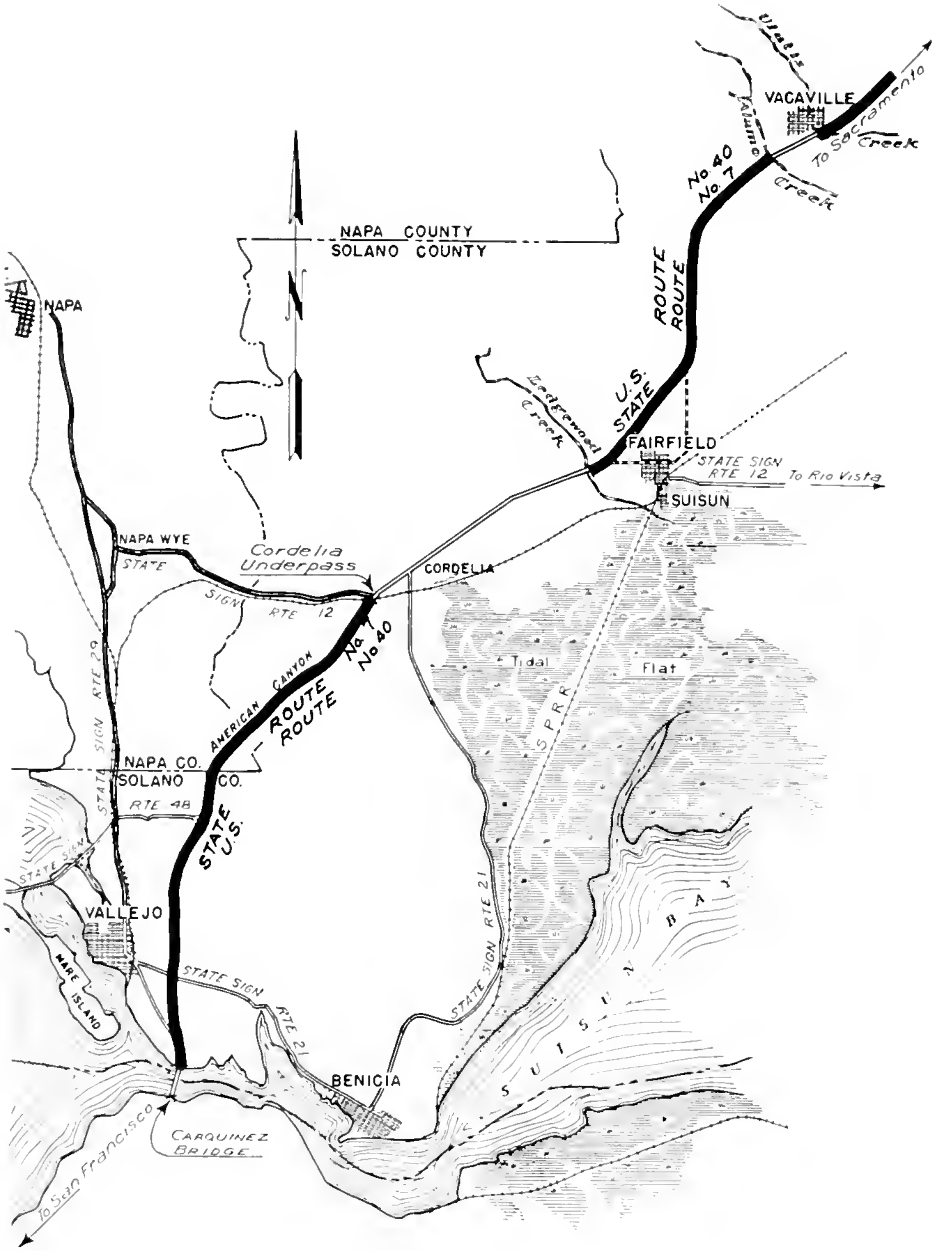
The major items on these three contracts make quite imposing figures. They include the following totals:

1,010,688	cubic yards roadway excavation
35,857,495	station yards overhaul
268,706	tons imported borrow
232,504	square yards cement-treated subgrade
54,167	tons untreated rock base
26,902	tons plant-mixed surfacing
55,076	cubic yards portland cement concrete
520,000	pounds reinforcing steel

In addition to the grading and paving the projects included construction of three bridges.

Under a separate contract, a traffic-actuated signal system was installed just west of Fairfield and lighting was

View on the American Canyon section with the new lane on the left



13 MILES EXPRESSWAY COMPLETED ON U.S. 40

DISTRICT X

placed at the east entrance of Fairfield. Illumination has also been placed at the transition to two-lane pavement west of Ledgewood Creek, and also at the transition to the two-lane pavement near Vacaville.

The total money involved in actual construction was $2,914,000.

The contractor on the 4.1-mile section near Vacaville was Harms Bros. and the Resident Engineer was E. L. Craun.

The other two sections were contracted to Parish Bros., and the Resident Engineer on both projects was Wm. L. Hurd. All work was supervised by M. C. Fosgate, Construction Engineer, under the general direction of C. E. Waite, District Engineer, and, after his transfer to Headquarters Office, J. G. Meyer, District Engineer.

Roseville Underpass

Continued from page 3 . . .

three inches of plant-mix surfacing on six inches of crusher run base and 15 inches of imported borrow.

Also in connection with the work, a large storm sewer was constructed and irrigation facilities were installed in the slopes and center dividing strips within the city to provide for watering of future planting and landscape developments.

As a part of the project, traffic actuated signal lights were installed at the intersection of Vernon and Grant Streets and all of the roadway within the city limits is lighted by means of mercury vapor and incandescent units. At some future date, it is anticipated that an approach will be provided to the south which will eliminate the present necessity of three right-angle turns to get on and off of Washington Street from the south.

Collier-Burns Act Funds

The Roseville Underpass became a reality as a result of the Collier-Burns Highway Act. During the war when state highway construction was at a very low ebb, plans were made by Governor Warren for a postwar highway program. Legislation was sponsored appropriating $12,000,000 for the preparation of plans and the acquisition of rights of way for postwar construction. The Roseville Underpass was one of the many projects included in this program.

At the 1947 Special Session of the Legislature, the Collier-Burns Highway Act was passed which increased highway revenues and provided for the development of a long-range highway construction program. From this program came the Roseville Underpass on which work was finally started October 27, 1948, after 20 years agitation by its local sponsors.

The project was designed and constructed by the Bridge Department, Division of Highways, under the direction of F. W. Panhorst, Bridge Engineer. The Guy F. Atkinson Company of San Francisco was the contractor, and the author acted as Resident Engineer for the Bridge Department.

Cooperation

Community Planning Spurs Freeway Progress in Alameda County

By NEWELL A. GROVER, Senior Right of Way Agent, District IV

As you speed along a new freeway through an urban area you probably do not realize the background of cooperative planning which has preceded the location and clearance of the right of way to be used in the development of the modern express highway which so well serves all people and which is so appropriately designated by California as a "freeway."

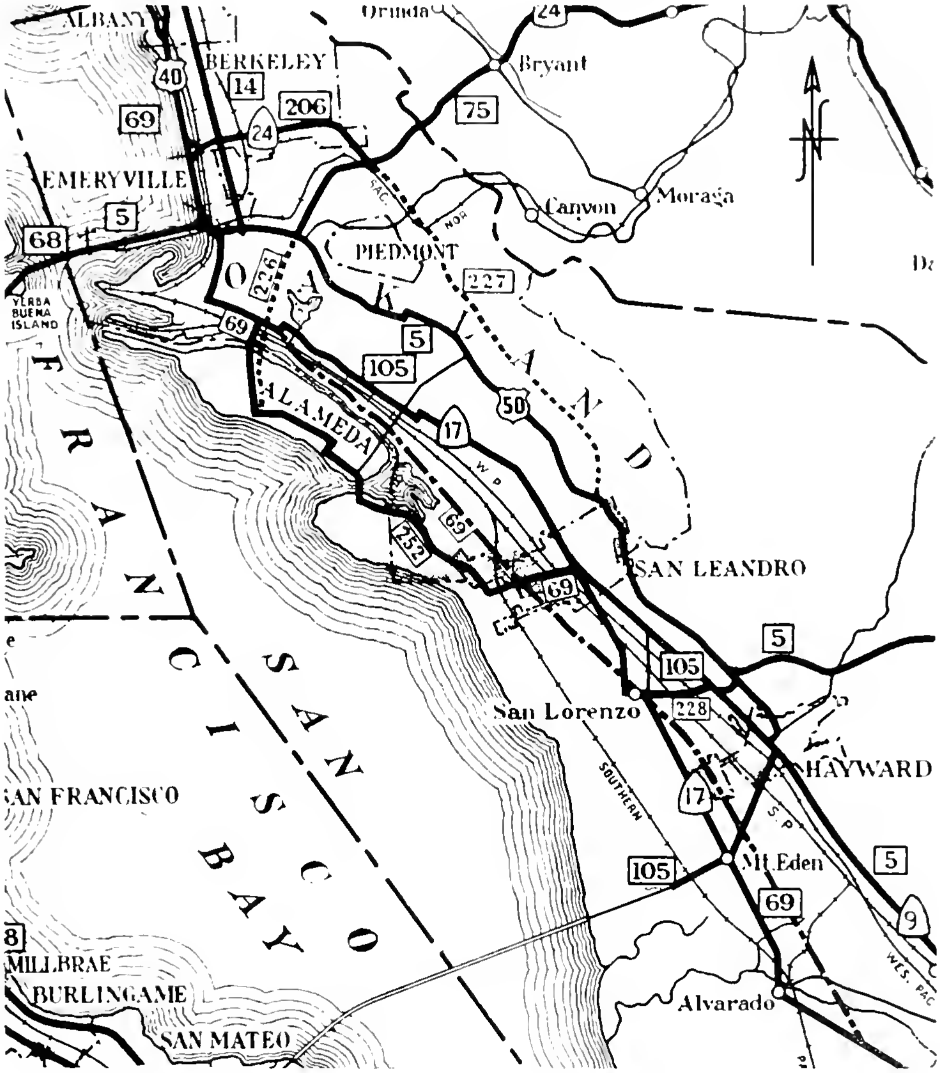
An outstanding example of the results of such planning may be seen along the East Shore Freeway through Alameda County, the first section of the Oakland portion of which was opened to traffic last summer.

During the middle 30's, state, city and county officials realized the necessity of looking forward to a fast, through artery to carry a large volume of motor traffic from the northerly to the southerly limits of the city and thence to the southerly county line.

Congested Areas

The metropolitan area of Oakland had its beginning along the level waterfront areas, with business enterprises developing near rail and water facilities and the early homes located not too distant from the centers of business and industry. By 1930, however, the city had built up so that there were very few sizeable vacant areas left between the bay and the foothills running parallel thereto. Existing sections of state highways serving north- and southbound traffic ran along MacArthur Boulevard, Foothill Boulevard and East 14th Street, respectively, carrying through-traffic along congested city streets with interference at each intersection in spite of boulevard stops and signals.

Early studies for Route 69 through Oakland explored the possibility of improving one of the existing city streets into a freeway, but it was finally decided that, as had been done in the case of the Bayshore Highway along the westerly side of San Francisco Bay, a new location should be provided through the Oakland area, which, insofar as practicable, would pass through the lesser developed areas between the easterly shore of the bay and the existing industries along the railroad lines.



State highway route through Oakland and vicinity with portion of Route 69, or East Shore Freeway, shown by broken line

Freeway Planned

After further extensive study a location was agreed upon for what was finally to develop into a portion of the East Shore Freeway, starting toward the bay from a point at Sixth and Fallon Streets, a short distance westerly of Lake Merritt, and then crossing over the the main line tracks of Western Pacific Railroad Company and those of Southern Pacific Company so as to run parallel with the shore of the bay to a point near 23d Avenue.

The route selected then crossed 23d Avenue to run approximately parallel with the Southern Pacific right of way until it again approached the shore area

Air view northerly along East Shore Freeway from point near Davis Street, San Leandro, showing built up subdivisions on each side of the freeway right of way reserved several years ago when the residential development started, and now being utilized for the advancing freeway construction. Brookfield Village and the 98th Avenue and Hegenberger Road overcrossings show in middle distance, San Leandro Creek marking the southerly city limits of Oakland in center, and subdivision near Davis Street in near portion of picture

in the vicinity of 50th Avenue, where the outline of the waterfront referred to as San Leandro Bay returned to a position not too far distant from the proposed freeway. Leaving 50th Avenue the location was across tide marsh areas until the shore line again swung southwesterly in the vicinity of the Oakland airport.

Not only did this route pass close to the industrial, business, and county office sections of the metropolitan county seat but it provided the advantage of a water-level location except where it was necessary to carry the freeway over railroad grade separation structures or across bridges requiring some clearance above water courses.

City Cooperation

The City of Oakland, in addition to its cooperation in the matter of planning for this freeway set aside the first large parcel of right of way required for the project, made up of approximately 22 acres of industrial waterfront property under the jurisdiction of its Board of Port Commissioners, and located between the so-called Low Tide Line of 1852, near Lake Merritt Canal, and 19th Avenue. The clearance of this parcel required the complete removal of several waterfront industries and the major rehabilitation of several other large plants with marine ways, warehouses, etc., as well as the construction of a new belt line railroad track between the southwesterly side of the freeway and the waterfront to replace the existing rail service furnished to the waterfront industries from a track on the Southern Pacific Company's right of way adjacent to but on the northeasterly side of the freeway.

Between 19th and 50th Avenues the acquisition and clearance of the right of way for the freeway, which was carried on over a period of several years, involved the complete removal of one large chemical plant, the rehabilitation of several other large industries, the removal or rehabilitation of numerous smaller industrial and commercial developments, as well

as the removal or rehabilitation of many homes.

San Leandro Expansion

After leaving 50th Avenue the projected location ran across what was then practically undeveloped country area. This country section, however, between Hegenberger Road and the environs of Hayward has since been subject to an expansive development of industries and homes so as to make it, from the planning point of view, one of the most interesting portions of the entire project.

Vacant industrial area closer to the center of Oakland had become quite scarce, with the result that more and more industries sought the larger locations available near San Leandro, and more and more workers turned in that direction for their homes. This resulted in a rapid growth, both industrial and residential, of the southerly portion of the City of Oakland, as well as the adjoining City of San Leandro. The residential expansion, accentuated by war conditions, spread to San Lorenzo where an entire new community known as San Lorenzo Village was grafted onto the south side of the trunk of the old village, with a resulting growth which is rightly a matter of pride to the developer, David D. Bohannon Organization, as well as to the entire area.

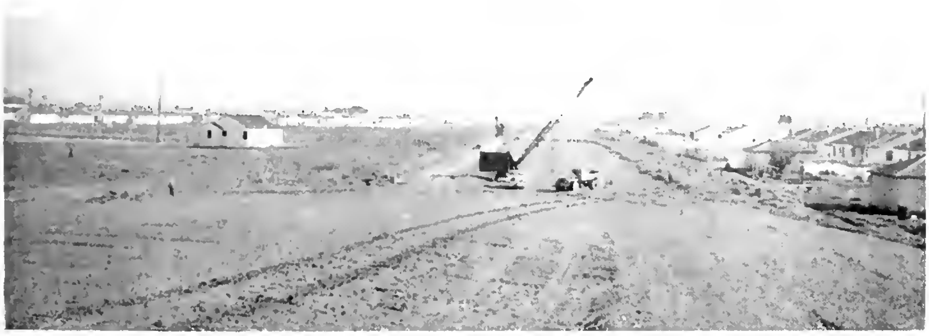
Recently completed section of East Shore Freeway just north of 98th Avenue, Oakland, with Hegenberger Road overcrossing in distance and Brookfield Village homes, built several years ago, on each side of freeway right of way

Brookfield Village

The first major subdivision effort along this vacant section of the East Shore Freeway was the development known as Brookfield Village. Tentative maps for this residential project had been prepared prior to the time that the freeway location was established, and so when these maps were presented to the City Planning Department, it immediately became necessary to redesign the subdivision in order to coordinate it with the future freeway. The subdivision streets were built parallel to the freeway with one tier of lots intervening, the rear of which abuts upon but has no access to the through highway, in accordance with the generally accepted design. The main cross artery to serve the subdivision, both before and after the freeway development, was 98th Avenue, and a sizeable commercial area of stores, service stations, etc., started to build up between the freeway location and San Leandro Street, which is a county road forming the present north and south artery just westerly of the Southern Pacific Company tracks.

The homes in the Brookfield Village on both sides of the freeway right of way were constructed and occupied during the war period to take care of workers in the growing industries throughout the East Bay area. The freeway right of way remained vacant, however, until 1949 when the construction project of the Division of Highways proceeded with the building of the freeway paving and the separation structure necessary to carry 98th Avenue over the freeway.

Construction of San Leandro Creek bridge and approaches proceeds in 1950 on reserved section of East Shore Freeway right of way north of Davis Street, San Leandro, where homes bordering the freeway were built several years ago



Other Subdivisions

Several other subdivisions went forward during this period in the vicinity of Davis Street, San Leandro, which is the next east-west artery south of 98th Avenue. Here also efficient planning by the County Planning Commission and the subdividers resulted in the development of residential areas located on both sides of the freeway right of way, which was set aside as a part of the cooperative master plan and which remains vacant today, although early freeway construction is now on the program of the State.

The next major subdivision to the south was the San Lorenzo Village, and here again the developers have cooperated by setting aside a wide vacant swath along the easterly side of the project to accommodate the ultimate East Shore Freeway.

Although the growth of San Lorenzo has been mainly residential, the area along the freeway location through San Leandro has witnessed the establishment of many large industrial and commercial plants, several of which were relocations required by the clearance of the freeway right of way through Oakland proper and the right of way for the Bayshore Freeway through San Francisco.

These industries are attracted to San Leandro by the readily available land, rail facilities, the fine surrounding residential area in which workers may

. . . Continued on page 54

New Route

Expressway Around Stockton Will Be Completed in June

By JOHN G. MEYER, District Engineer

June, 1950, will see the completion of a contract awarded to United Concrete Pipe Company in June, 1949, for the paving and completion of the expressway project located on the eastern fringes of the City of Stockton.

Its location met with the approval of the Stockton City Council, a large majority of the business men of this area, and the San Joaquin County officials. The finish of this contract will complete the project which was described in more detail in an article published in the July-August, 1949, issue of this magazine and which was started by a previous contract held by Lord and Bishop and M. J. B. Construction Company in June of 1948.

This expressway is a portion of Rt. U. S. 99 and begins at the Mariposa Road one and one-half miles south of Stockton. It extends thence in a northerly direction over new right of way to the Calaveras River where it joins an eight-mile piece of four-lane divided expressway between the Calaveras River and Lodi. The rerouting saves through traffic 1.57 miles in distance as well as a tedious drive through a business area in Stockton.

Avoids Congested Area

The project also includes a two-mile extension of U. S. 50, locally known as Charter Way, from Wilson Way in Stockton to join the expressway at a point 300 feet south of Main Street. The U. S. 50 portion includes a structure over Mormon Slough as well as an underpass under the Santa Fe Railroad. In making its connection with U. S. 99, an overhead separation is constructed which allows north-bound traffic to cross the expressway and then blend in with through traffic near the south entrance of the Main Street overhead or with local streets.

The two traveled ways from Mariposa Road to Calaveras River are of Portland cement concrete, each consisting of one 11-foot lane and one 12-foot lane. The outside and inside shoulders consist of plant-mix surfacing three feet and two feet in width, respectively, adjacent to the pavement edges, with bituminous surface treatment applied to the remaining five-foot and three-foot widths. The speed change lanes and the inlet and outlet ramps consist of plant-mix surfacing on either untreated rock base or Portland cement concrete base.

Four-lane Divided Highway

On U. S. 50 there is a four-lane divided highway from Wilson Way to D Street, a distance of approximately 3,600 feet, where the northbound traffic to Stockton uses a new 23-foot Portland cement concrete traveled way and the southbound traffic uses the existing pavement which is being resurfaced. From D Street on to the expressway the construction consists of a two-lane 23-foot Portland cement concrete traveled way with combination shoulders of three-foot plant mix adjacent to the edges of the pavement and bituminous surface treatment on the outer five feet. Right of way for Route 50 has been acquired for future development to four-lane throughout.

New twin bridges for north and southbound traffic at diverting canal across Mormon Slough on U. S. 99

These aerial views show old and new locations of U. S. 50 and U. S. 99 in area covered by new Stockton Expressway

The structures on U. S. 99 were a major item of work, there being an underpass under the Santa Fe Railroad, twin bridges across Mormon Slough, an overhead for the connection of U. S. 50 and the overhead at Main Street, a pedestrian underpass at Miner Avenue, twin bridges across the diverting canal, an underpass under the Central California Traction Company Railroad, an overhead to connect northbound traffic leaving Stockton to the expressway as well as a bridge across the Calaveras River and an extension and widening of the original Calaveras River Bridge.

Flat Curvature

The terrain through which this project is located is level and while there are eight curves in the project,

. . . Continued on page 50

Truck Turns

State Makes Exhaustive Study of Truck-Trailer Paths on Short Radius Turns

By J. C. YOUNG, Traffic Engineer, Division of Highways

The prevalence of large truck and trailer and tractor-truck semitrailer combinations on California highways makes the room required for these vehicles on short radius turns at intersections and connecting ramps an important consideration in geometric design.

In order to determine lane widths and shapes for minimum design, several large truck combinations were driven in short radius turns on an airport, and the resulting tracks were measured and plotted. This report presents the results of the trials and provides recommended curve data and lane widths which will accommodate the largest legal vehicles in California. These maximum legal vehicles are 60 feet in over-all length. The maximum legal length of the trailer portion of a tractor-semitrailer combination is 35 feet.

Track widths are given in tabular form for various radii and central angles. The track width of a legal semitrailer turning 180 degrees on a 50-foot outside radius is 20.2 feet. The sharpest turn recommended is a 50-foot radius for the outside lane edge. Allowing a two-foot tolerance, the radius of the outside wheel track becomes 48 feet for which the net track width is 21.0 feet. The lane width including a tolerance of 2.0 feet on both sides is 25 feet.

CHANNELIZED INTERSECTIONS and grade separations frequently require turning lanes to provide for very low hourly traffic volumes; in other words, for "occasional" vehicles. It is essential to provide for these occasional turning movements, but it is impracticable to provide long radius curves which more important turning movements would justify.

California design for cases of this kind frequently provide curbs on both sides of the turning lanes, or, in the case of channelized intersections, islands whose boundaries comprise segments of imaginary turning lanes. In order to maintain traffic flow in these turns, they must be passable by the largest legal vehicle, although this class comprises a small percentage of total traffic.

Apparatus used for making trace on pavement (Front overhang of bus)

For the purpose of presenting this material in the form of a magazine article it was necessary to reduce the drawings of test truck paths to an odd scale. A few drawings, not essential to the sense of the text, are omitted entirely. Readers who are interested in scaling dimensions may write to the State Highway Engineer, attention of J. C. Young, Traffic Engineer, and drawings on a scale of 1″ = 20′ will be furnished. Available drawings which are not shown in this article include minimum turns for the 2-axle truck, 3-axle truck (left turn), 2-axle bus, truck and trailer type 3-3, train type 2-S2-2; and 180°, 50-foot radius turns of the 2-axle bus, 3-S2, 3-3, and 2-S2-2.

It has been California practice to lay out a geometric line, i.e. compounded circular curves, as the inside lane edge, and to allow a lane width from this edge which is dependent on radius alone. However, the width needed changes not only with the radius of the curve but also with the central angle. Furthermore, increasing the inside edge radius does not necessarily make the lane passable.

Available information on lane widths required by semitrailers is based on experiments made about ten years ago on a semitrailer having an over-all wheel base of 35 feet and a distance from kingpin to rear axle of 21 feet. Measurements made of random vehicles in California show that in 1949, 98 percent of all California 3-S2 combinations exceed 35 feet in over-all

Apparatus used for making trace on pavement (Rear wheel of trailer)

wheel base and 88 percent of them exceed 21 feet in distance from kingpin to forward rear axle.

It was therefore decided to conduct physical experiments with the view of determining simple geometrically shaped paths which would accommodate large vehicles. It would, of course, be possible to lay out a circular inside edge, adding sufficient width for any vehicle to negotiate the turning lane around the circular curve. In this case, it would still be necessary to determine the widths experimentally. However, circular inside edges call for considerable extra pavement which would be unusable by any vehicles; even passenger cars.[1]

VEHICLE TYPES

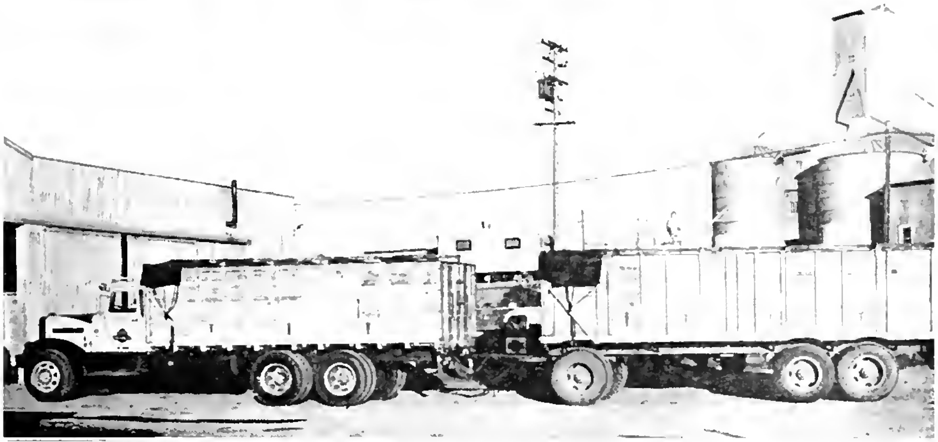
With the cooperation of the trucking industry and truck and trailer dealers, critical vehicles of types which approach or equal the legal size limits in California were taken to an abandoned airstrip and driven around various kinds of turns.

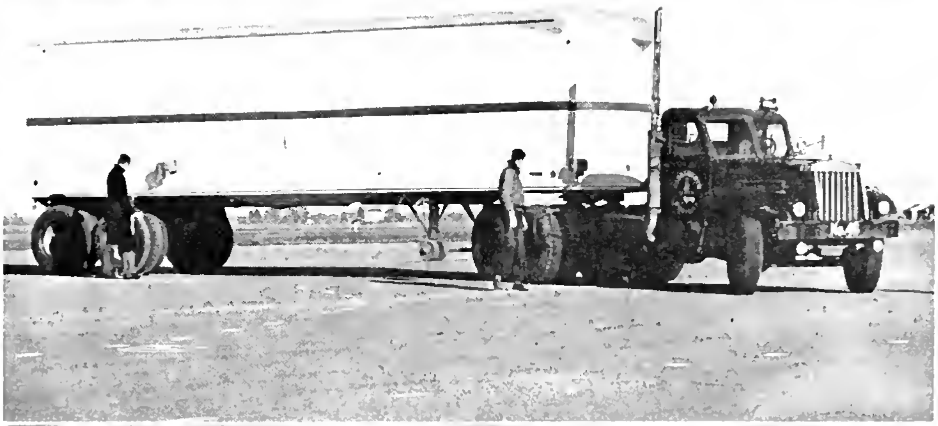
The vehicles used are diagrammed in Plate 1 and are briefly described as follows:

a. 2-axle truck, 17.5 ft. wheel base, 25.4 ft. over-all length
b. 3-axle truck, 21.0 ft. wheel base, 29.6 ft. over-all length
c. Tractor-truck and semitrailer type 3-S2, having:
   20.0 ft. wheel base, tractor
   29.0 ft. kingpin to rearmost semitrailer axle
   46.0 ft. over-all wheel base
   50.8 ft. over-all length
   35.0 ft. over-all length of semitrailer van (maximum legal size)
d. Tractor-truck, semitrailer and full trailer, type 2-S2-2, 60.0 ft. over-all length (maximum legal length)
e. Truck and trailer type 3-3, 60.0 ft. over-all length (maximum legal length)
f. 2-axle bus, 22.0 ft. wheel base, 34.7 ft. over-all length
g. Tractor-truck and articulated semitrailer type 3-AS2, having:
   19.8 ft. wheel base, tractor
   31.3 ft. kingpin to rearmost axle
   48.1 ft. over-all wheel base
   53.0 ft. over-all length
   35.5 ft. over-all length of semitrailer van

Four of the vehicles used in the tests are shown in accompanying photographs.

The relative importance of the various types in actual road use, and a





UPPER—Tractor-truck, semi-trailer and trailer, Type 2-S2-2. BELOW—Truck and trailer, Type 3-3. NEXT—Tractor-truck and semitrailer, Type 3-S2. BOTTOM—Two-axle bus

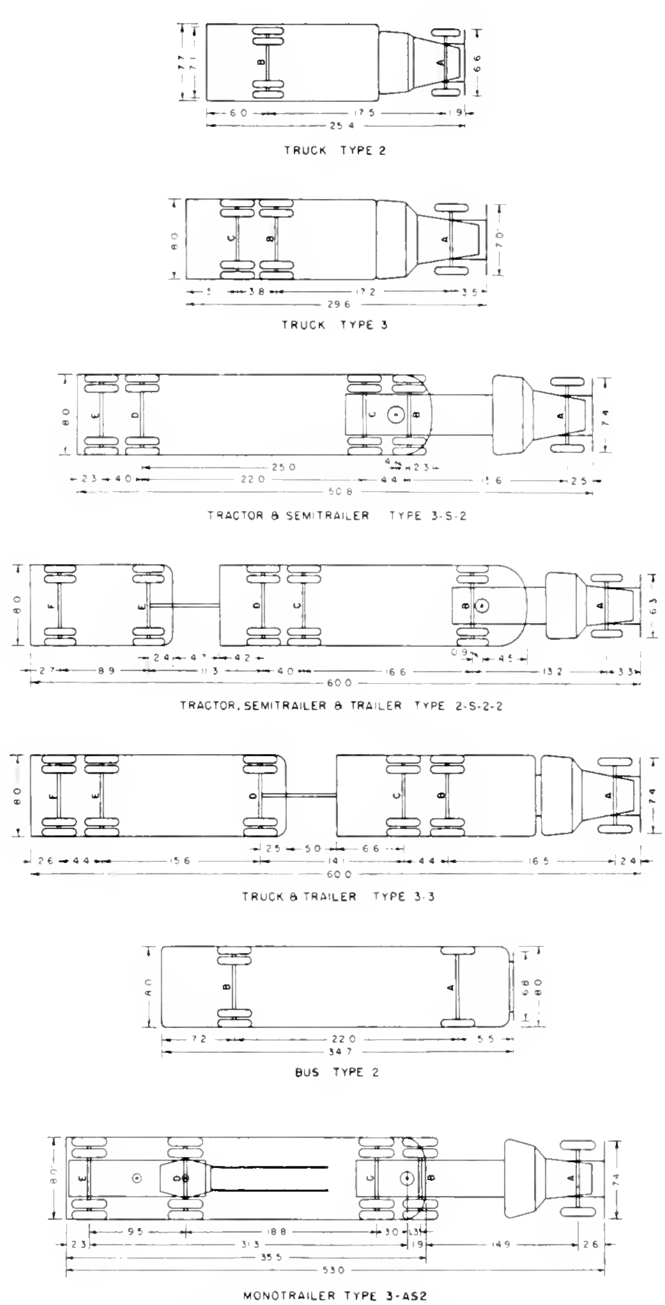
[1] A discussion of the merits of compound curves for inside lane edges on sharp turns is found in "A Policy on Intersections at Grade," American Association of State Highway Officials (Washington, 1940) (pp. 13-16).

comparison of the test vehicles with those on the road, is afforded by the annual Loadometer Survey conducted by the California State-wide Highway Planning Survey. This survey consists of a random sample of all commercial vehicles at 20 points throughout the state highway system.

Semitrailers Critical Vehicles

Of all vehicles having more than four tires (that is, of all trucks and combinations exceeding the pickup and panel delivery type), 30 percent are semitrailers. Of these 30 percent, one-half are of the 3-S2 type. It will be developed later in this report that the 3-S2 is the critical vehicle on turns, insofar as lane width is concerned, and the prevalence of this type on the road signifies its importance in design. The vehicle used for the tests (see photograph) is typical of the 3-S2's found on the road. During the 1949 survey, it was found that in over-all wheel base, 48 percent of the type were within two feet of the wheel base of the test vehicle (14 percent were from two to four feet longer); and in distance from kingpin swivel to forward rear axle of the semitrailer, 57 percent were within one foot of the test vehicle (10 percent were from one to three feet longer, and 33 percent were shorter by more than one foot).

Two points are made here: First, that the vehicle used for the tests is not so exceptionally large that it can ever be ignored in design; and second, that the vehicle used for tests, for purposes of lane width determination, is large enough (i.e., long enough from swivel to axle) so that the data derived from the tests may be depended upon to accommodate practically all legal vehicles in California. In fact, the van body on the test vehicle was 35.0 feet, exactly the legal limit for any single unit, and it would be extremely unlikely that a van of this length could have a significantly longer wheel base than the test vehicle.



Dimensions of Test Vehicles Plate I

DESCRIPTION OF TESTS

Tests made included:

1. Runs of each vehicle type to determine the sharpest curve which could be used for the outside lane edge that will accommodate all vehicles.

2. Runs of each vehicle type on predetermined paths, to determine lane widths for various curve shapes. These runs were made in the following separate ways:

   a. Inside rear wheel following predetermined compound curves of various radius combinations.

   b. Inside rear wheel following circular path.

   c. Outside front wheel following circular path.

In all the tests an apparatus was mounted on the vehicles to produce marks on the pavement, as shown in accompanying photographs. The apparatus was very simple and consisted essentially of reservoirs to hold the marking fluid (whitewash), together with outlet tubes which were positioned to flow from critical points on the vehicles, namely:

1. The outer front end of the vehicle, which usually overhangs the outer front wheel path on short radius curves;
2. The outer front wheel at the hub;
3. The inner rear wheel of the tractor, or leading vehicle of combinations;
4. The inner rear wheel of the trailer.

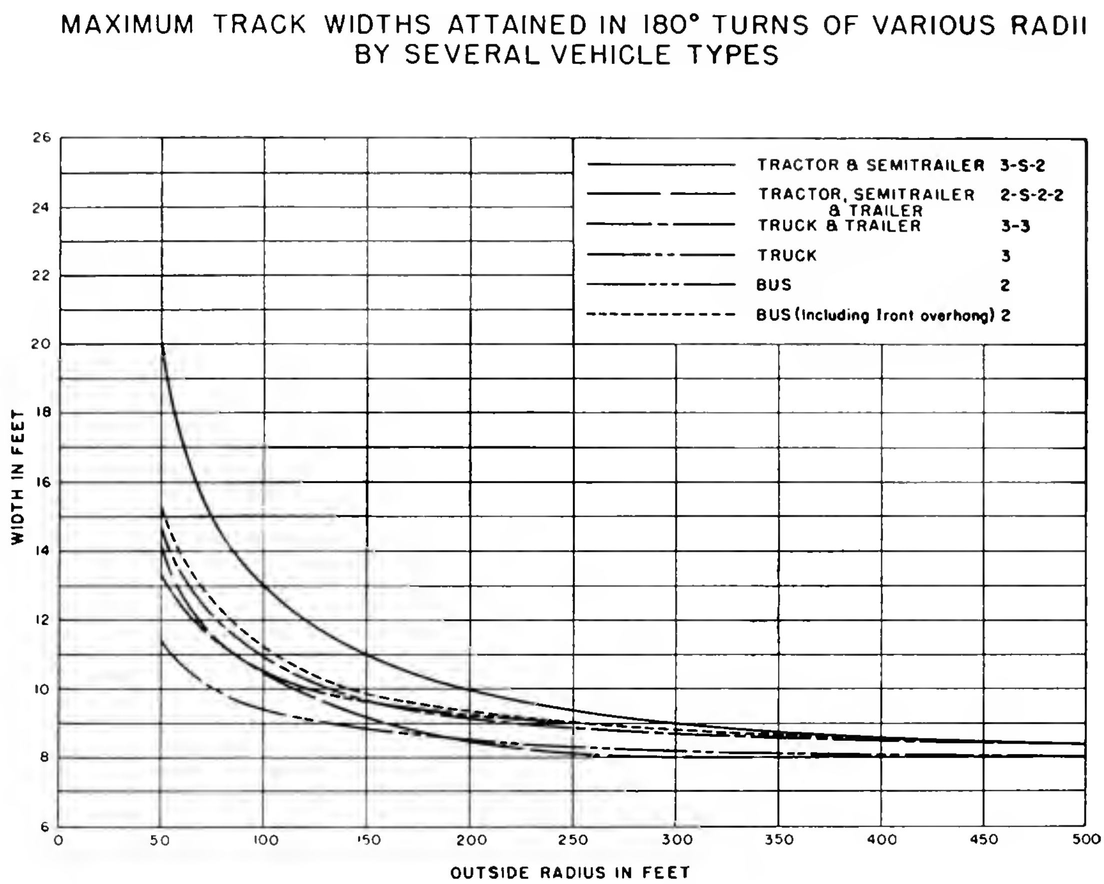


Plate 2

The tests consisted merely of driving the several vehicles at slow speeds (3 to 6 m.p.h.) around various types of curves, leaving whitewash traces at the outside and inside edges of the paths occupied. The traces were then recorded in terms of polar coordinates, and were later plotted up in the office on large scale drawings (5 feet to the inch, or 1:60).

RESULTS OF THE TESTS

Sharpest Curves by Various Vehicles

In this phase of the tests, each test vehicle was successively driven in right-hand and left-hand turns on a blank pavement, leaving marks as they fell; in other words, it was not attempted to follow a presurveyed mark. In each case, the steering wheel was "cramped" over as far as it would go. *Typical paths are shown in Plates 9 to 12.*

The critical radii are listed in *Table 1.* The minimum radius for the three-axle truck is the largest of any of the vehicle types; 45.0 feet for left turns and 43.0 feet for right turns. The same truck towing a full trailer describes the same outer wheel path. All other types and combinations having a shorter wheel base in the tractor unit are able to turn within these outside curves.

Required Outside Radius

It is seen in *Table 1* that several vehicles require an outside radius of at least 43 to 45 feet when being driven under ideal conditions and at very low rates of speed (the bus, in making a right turn, requires a 42.8-foot radius for the front tire, but the front end overhang is 2.3 feet).

It was concluded that for minimum practical turns which would be built to accommodate all vehicles, 50 feet is the least radius of front wheel track which would be worth investigating for lane widths. It may also be noted in *Table 1* that the types requiring the greater lane widths were those whose outside radius was less than the minimum for other types. In other words, turns must be built with an outside radius sufficient to accommodate a bus, but must be wide enough to accommodate a semitrailer. The semitrailer lane width shown in *Table 1* is not significant, because turns of such short outside radius (33.6 feet) are not practical or possible of negotiating by other large vehicles.

Transition From Tangent to Curve

Before proceeding to discuss the test runs on fixed paths, attention is invited to some other facts revealed by the minimum radius drawings. First, transition (variable radius) curves comprise a portion of the wheel paths of both front outside and rear inside wheels. For long combinations making turns of moderate cenrral angles, the inside track is wholly transitional. For this reason, minimum possible turns are difficult to describe other than graphically. The actual paths drawn

to scale are almost the only way of testing design.

Second, the transition at the beginning of the outside wheel curve attains a *sharper* curvature than the minimum radius *(see Plate 9)*, and the offset from the circular curve (produced) is minor at slow speeds. It is apropos here to call attention to a common fallacy; namely, that when entering a circular curve from a tangent, the front wheels must be abruptly changed from a straight-ahead position to a specified angle. On the contrary, the only way a vehicle can enter a circular curve with the front wheel is to turn the steering gear gradually.

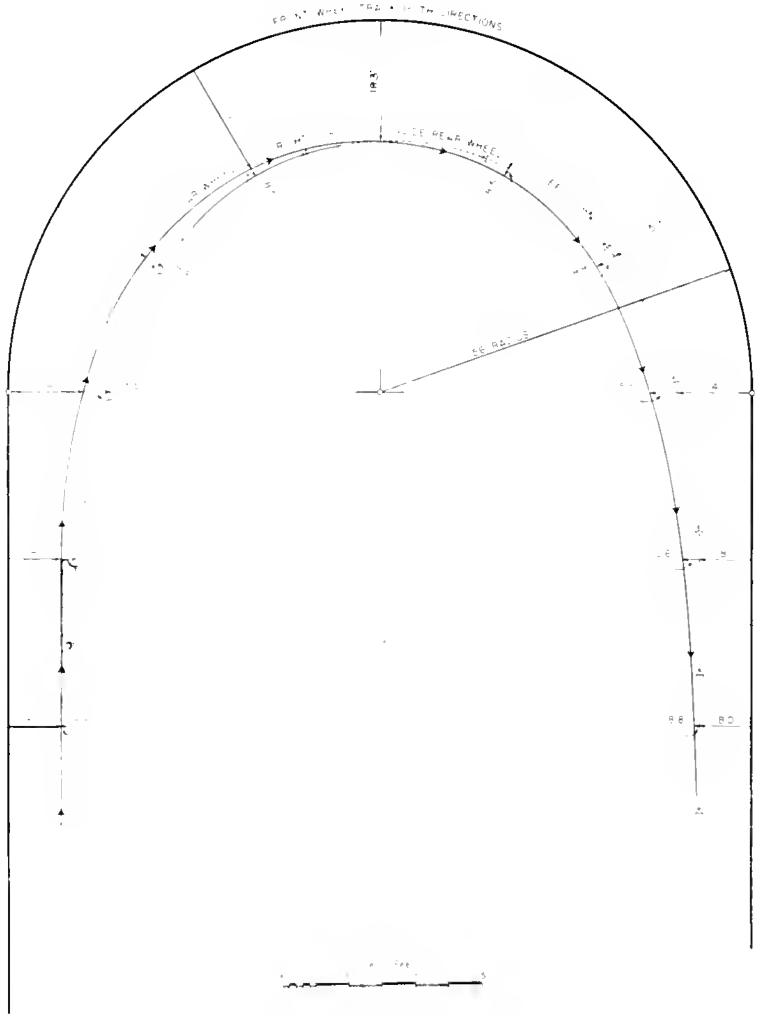
Circular Curve Not Abrupt

Suppose that the vehicle is traveling on a straight line, is brought to a halt, and the front wheels are turned to an angle while the vehicle is in a standing position. Upon resuming the motion of the vehicle, the front wheels will take off in the direction in which they are pointed, and their traces will form a definite angle, rather than a point of tangency. This means that far from being impossible, as has been held in many quarters for 30 years or more, a circular course *is* negotiable from a tangent, and at slow speeds is the natural way for a vehicle to change direction.

Third, the tractor-truck semitrailer invariably makes a wider track than the truck and trailer, although the latter is longer. *Comparison of Plates 11 and 12, which show the effect of the tongue and swiveled axle on the full trailer, reveals the reason for the difference in width.*[2]

COMPOUND CURVES

In an attempt to find out what lane widths would be required for symmetrical compound inside edge curves which have been in use in California, five such curves, having various central angles, were surveyed and painted on the pavement. These curves are described as follows:



Left-hand and Right-hand Turns on 56-Foot Outside Radius; Vehicle Type 3-S2 Plate 3

3-center compound curves

Central angle degrees	R_1 feet	R_2 feet	R_3 feet	Offset for R_2 feet
60	120	32	120	5
90	120	32	120	5
120	120	32	120	5
135	120	32	120	5
180	120	32	120	5

It was found that it was very difficult for the drivers to follow these tracks with their rear wheels, requiring continuous jockeying and resulting in an irregular wobble path for the front wheels. Furthermore, the general path of the front wheel followed no describable geometrical form because the natural path of the truck calls for a longer transition at the end of the curve than it does at the beginning.

It was then attempted to drive the trucks around a circular path for the inside lane edge. In other words, it was attempted to make the rear wheel follow a circle. This resulted in the front end making a sort of pear shaped line, which would be very impractical for purposes of tabulating or design, since it would bulge out into the adjacent lanes at take-off and merging points.

[2] The statement made in this paragraph applies to the conventional semitrailer with fixed axles. There is a patented type of trailer which has no front axle and in that respect is a "semi" trailer, but has articulated rear axles, and for a given body length occupies considerably less lane width.

A discussion of this trailer is included in the appendix of this article.

CURVE DATA FOR INSIDE AND OUTSIDE EDGES OF LANES WHICH WILL ACCOMMODATE LARGE SEMITRAILER COMBINATIONS

Table 7

RADIUS OF OUTSIDE EDGE	RANGE OF CENTRAL ANGLES	THREE-CENTER COMPOUND CURVES FOR INSIDE LANE EDGE				
R_o	Δ	R_1	R_2	R_3	e	s
FEET	DEGREES	FEET	FEET	FEET	FEET	FEET
50 (2)	60° to 90° (1)	180	45	250	59	15
	91° to 180°	120	30	200	48	4.5
	OVER 180°	80	25	200	50	0
60	60° to 90° (1)	120	55	300	69	13.5
	91° to 210°	120	40	300	58.5	1.5
	OVER 210°	80	38	300	60	0
67	60° to 90° (1)	120	60	300	74	10
	91° to 180°	120	49	300	66	2.5
	OVER 180°	100	46	300	67	0
75	0° to 59°	200	90	300	104	17
	60° to 210°	120	57	300	74	1.5
	OVER 210°	120	55	300	75	0
100	0° to 30°	220	(3)			
	31° to 60°	200	90	400	104	5.5
	OVER 60°	120	83	400	100	0
150	0° to 25°	300	(3)			
	OVER 25°	300	135	400	150	0
200 (4)	0° to 20°	400	(3)			
	OVER 20°	400	186	400	200	0

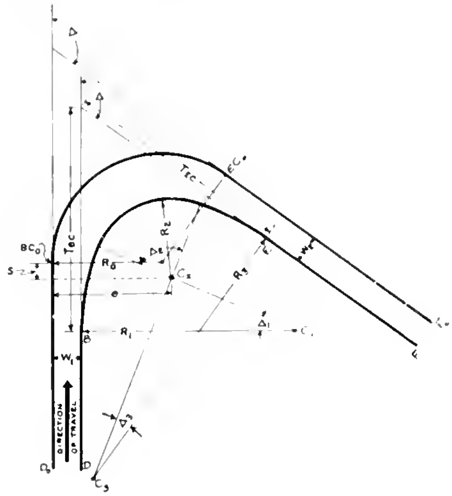
(1) Radii of less than 75 feet for angles of less than 60°, or less than 100 feet for angles less than 40°, are not recommended because of short lengths

(2) 50 feet radius will allow for practically no initial speed of large vehicles, this set of figures for use in critical locations only

(3) Single circular curve

(4) For any radius between 200 and 500 feet use concentric curves, inside radius 14 feet less than outside radius, with circular transition curves of twice the central radius

Plate 4



FORMULAS FOR LAYOUT COMPUTATIONS

$$\cos \Delta_1 = \frac{R_1 - (e - W_1)}{R_1 - R_2}$$

$$\cos \Delta_3 = \frac{R_3 - (R_o - W_2) - S \sin \Delta - (e - R_o) \cos \Delta}{R_3 - R_2}$$

$$T_{BC} = (R_1 - R_2) \sin \Delta_1 + \frac{R_o - W_2 + S \sin \Delta + (e - R_o) \cos \Delta}{\sin \Delta} - \frac{(e - W_1)}{\tan \Delta}$$

$$T_{EC} = (R_3 - R_2) \sin \Delta_3 + \frac{(e - W_1)}{\sin \Delta} - \frac{R_o - W_2 + S \sin \Delta + (e - R_o) \cos \Delta}{\tan \Delta}$$

The next step was the construction of nonsymmetrical 3-center curves, which were laid out as follows:

3-center compound curves

Central angle, degrees	R_1 feet	R_2 feet	R_3 feet	Offset for R_2 From approach tangent feet	Offset for R_2 From leaving tangent feet
90	120	40	120	4	14
120	120	40	120	4	14
180	120	40	120	4	14

Somewhat the same difficulty was found in running these curves that occured with the previous set. However, the outside track followed a generally circular path.

CIRCULAR CURVES

In contrast to the process of predetermining a geometric path for rear wheels and the difficulty of attempting to develop the outside curve which corresponded, it was found practical to keep the front wheels on a circular path and simply to record the spiral path of the rear wheel which naturally followed. A circular path for the front wheels is also a natural path and for turns at slow speeds the transitions at beginning and end of the curve are short and of small offset. For the same reason that it was found difficult to drive anything but a circle or definite geometric path with the front wheel during the tests, it may be concluded that channelization or ramp design should similarly be based upon geometrical paths for the outside front wheel, using this path as the independent line, and determining the inside edge as a dependent function thereof.

Circular curves of the following angles and radii were painted on the ground and run with the front wheel of each vehicle type on the curve:

Radius, ft.	Central angle
50	180°
53	90°, 120°, 180°
56	90°, 120°, 180°
75	180
100	180°
200	160
300	136°
500	100°

The maximum track width attained by each vehicle type in making a 180-degree turn on each radius is shown on *Plate 2*. These widths varied from slightly greater than the eight-foot vehicle width at radii greater than 300 feet to more than 20 feet for the semitrailer at 50-foot radius. The semitrailer combination produced a wider track than any other type at all radii. It was from 0.5 foot wider, on a 250-foot radius, to five feet wider on a 50-foot radius, than any other type.

Since the semitrailer track is adequate, at outside radii of 50 feet or greater, for all other types, the remainder of this report is devoted to the detailed results obtained from runs of that vehicle type. Design which provides for this type is the minimum permissible, and tracks made by other vehicles are only of academic interest.

Plate 3 shows the tracks made by the 3-S2 in turning 180 degrees both left and right on a 56-foot outside radius. The left and right paths are congruent if folded left hand to right hand. This fact was tested for other radii as well, and it was found true that left and

right turns are always congruent provided the outside radius remains the same.[3]

Plates 5, 6, 7 and 8 show the tracks made by the 3-S2 semitrailer combination for various radii and angles. These drawings were constructed from field notes of the marks actually produced by the vehicle in following the stated circular curves with the outside front wheel, through 180 degrees of azimuth. The off-going spiral of the rear wheel is a constant shape for every angle and radius, the length of which varries according to the total track width attained. When the angle between the tractor and the semitrailer has reached the value necessary to produce a certain track width, and the front wheel is then driven along a straight line, the process by which the angle was attained has no effect on the future course of the rear wheel.

Tables 2 to 6 show track widths for each radius with various central angles. They were prepared by scaling from large scale original drawings of the plates.[4] Track widths for radii and central angles not shown in the tables may be interpolated, bearing in mind that the test methods and the nature of the work do not justify accuracy closer than one-half foot, plus or minus. The widths are shown to a tenth of a foot for convenience and to smooth out irregularities which would result if one-half foot deviations were connected on a large scale layout.

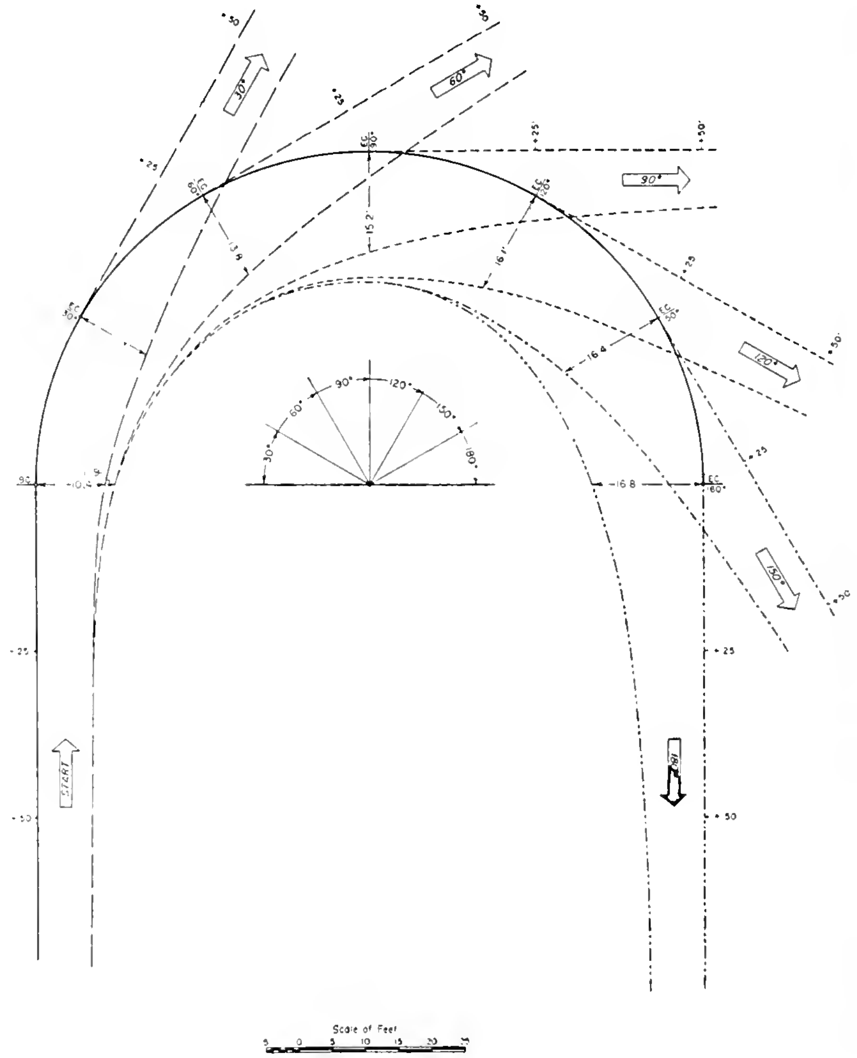
APPLICATION TO DESIGN

As has been explained above, the outside wheel track has to be tied in to the inside wheel track in order to be sure that the resulting lane will have adequate width. The curves made by the two wheels will not necessarily be concentric.

For practical application in most cases, it will be feasible to lay a circular curve which represents the outside of the lane. The problem then becomes to lay a geometric curve of some shape which will provide adequate width within this outside circular curve, and at the same time will not create a large area of unusable pavement.

For the convenience of designers, inside lane edges which correspond to certain outside edge radii, namely 50, 60, 67, 75, 100, 150, and 200 feet, have been determined by a process of trial and error, and are listed in *Plate 4*. The curve data in this table will closely approximate the lanes required for the radii specified, and may be used if these radii will fit topographic or other physical controls.[5]

The data given in *Plate 4* may also be used to test intersections which include islands or other obstructions, by laying



Semitrailer Wheel Tracks, 50-ft. Outside Radius — Plate 5

[3] The absolute minimum turn that can be made to the right has a smaller radius than the minimum turn which can be made to the left. However, if a right turn is made at a radius equal to the minimum left turn radius, the track widths of both will be equal.

[4] Table 3-A is interpolated from the other tables for the convenience of designers who desire to use a 67-foot radius for outside lane edge.

[5] A three-center compound curve for an inside pavement edge may be regarded as a circular curve at a widened distance from the outside edge, or centerline, with circular transitions at each end from the non-widened approaches to the widened center curve. This concept is not new. It is found, as an example, in the California Division of Highways "Manual of Instructions for Surveys and Plans" (1931) (p. 108).

imaginary lanes equal to those in the table.

Should the outside radii given in *Plate 4* not prove adaptable to the particular problem at hand, as will often be the case when designing complex interchanges or any other junctions involving structures, recourse may be had to the track width tables *(Tables 2 to 6 inclusive)*.

In using either table it is important to keep in mind:

(1) *The outside* (i.e., the side farthest from the center of the curve) *must be tied in with the inside edge.* Merely laying out the inside lane edge without a tied-in outside edge is not sufficient to insure a passable lane.

TABLE 1

MINIMUM RADIUS TURNS

Vehicle type	Direction of turn	Radius, feet: Outside front wheel track	Radius, feet: Inner rear wheel track	Track width, feet
Truck—2 axle	Right	33.2	22.0	11.2
	Left	39.8	29.6	10.2
Truck—3 axle	Right	43.0	30.7	12.3
	Left	*45.0	33.0	12.0
Bus—2 axle	Right	42.8	28.9	13.9
	Left	41.8	28.0	13.8
Semitrailer 3-S2	Right	33.6	0.0	**33.6
	Left	43.4	20.6	22.8
Full trailer 3-3	Right	43.0	26.6	16.4
	Left	*45.0	29.0	16.0
Train 2-S2-2	Right	31.1	†	†
	Left	34.0	15.4	18.6

* Controlling Radius
** Maximum track width
† Undetermined; continuous spiral

TABLE 2

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 50-FOOT OUTSIDE RADIUS

Tangent deflection Δ	Interior angle	Width in feet at various stations [1]: BC —50	BC —25	BC	Central angle ahead of BC: 15°	30°	45°	60°	75°	90°	105°	120°	135° or more	Back of EC: 30°	15°	EC	EC +25	EC +50
30°	150°	8.0	8.5	10.4	11.8											11.4	9.1	8.5
45°	135°	8.0	8.6	11.8	13.5										14.0	12.9	9.7	8.5
60°	120°	8.0	8.6	11.9	14.1	15.3									15.3	13.8	10.0	8.5
75°	105°	8.0	8.6	11.9	14.5	16.0								16.8	16.4	14.7	10.4	8.6
90°	90°	8.0	8.6	11.9	14.5	16.3	17.2							17.8	17.2	15.2	10.6	8.8
105°	75°	8.0	8.6	11.9	14.5	16.3	17.6	18.3						18.6	17.8	15.8	10.8	8.8
120°	60°	8.0	8.6	11.9	14.5	16.3	17.6	18.5	18.8					19.0	18.2	16.1	11.0	8.8
135°	45°	8.0	8.6	11.9	14.5	16.3	17.6	18.5	19.2	19.5				19.5	18.7	16.4	11.0	8.9
150°	30°	8.0	8.6	11.9	14.6	16.3	17.6	18.5	19.2	19.6	19.7			19.6	18.7	16.4	11.1	8.9
165°	15°	8.0	8.6	11.9	14.5	16.3	17.6	18.5	19.2	19.6	20.0	20.1		19.9	19.0	16.5	11.1	9.0
180°		8.0	8.6	11.9	14.5	16.3	17.6	18.5	19.2	19.6	20.0	20.2	20.2	20.1	19.0	16.8	11.1	9.0

[1] Net tire marks, measured along radial lines of outside circular curve.

TABLE 3

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 56-FOOT OUTSIDE RADIUS

Tangent deflection Δ	Interior angle	Width in feet at various stations [1]: BC —50	BC —25	BC	Central angle ahead of BC: 15°	30°	45°	60°	75°	90°	105°	120°	135° or more	Back of EC: 30°	15°	EC	EC +25	EC +50
30°	150°	8.0	8.1	10.3	11.8											11.1	9.0	8.4
45°	135°	8.0	8.1	11.3	13.4										14.0	12.7	9.6	8.4
60°	120°	8.0	8.1	11.4	13.6	14.7									15.0	13.5	10.0	8.5
75°	105°	8.0	8.1	11.4	13.7	15.3								16.0	15.8	14.2	10.1	8.6
90°	90°	8.0	8.1	11.4	13.7	15.3	16.3							16.8	16.4	14.5	10.2	8.6
105°	75°	8.0	8.1	11.4	13.7	15.3	16.5	17.2						17.5	16.9	15.0	10.4	8.7
120°	60°	8.0	8.1	11.4	13.7	15.3	16.5	17.2	17.7					17.9	17.1	15.0	10.5	8.7
135°	45°	8.0	8.1	11.4	13.7	15.3	16.5	17.2	17.8	18.3				18.2	17.5	15.4	10.6	8.8
150°	30°	8.0	8.1	11.4	13.7	15.3	16.5	17.2	17.8	18.3	18.4			18.4	17.5	15.5	10.6	8.8
165°	15°	8.0	8.1	11.4	13.7	15.3	16.5	17.2	17.8	18.3	18.5	18.5		18.4	17.6	15.5	10.6	8.8
180°		8.0	8.1	11.4	13.7	15.3	16.5	17.2	17.8	18.3	18.5	18.5	18.5	18.4	17.6	15.5	10.6	8.8

[1] Net tire marks, measured along radial lines of outside circular curve.

TABLE 3-A

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 65-FOOT OUTSIDE RADIUS

Tangent deflection Δ	Interior angle	Width in feet at various stations[1]																
		BC —50	BC —25	BC	Central angle ahead of BC										Back of EC	EC	EC +25	EC +50
					15°	30°	45°	60°	75°	90°	105°	120°	135°	150° or more	15°			
30°	150°	8.0	8.2	10.1	11.6											11.0	9.0	8.2
45°	135°	8.0	8.2	10.6	12.4										13.0	11.9	9.4	8.3
60°	120°	8.0	8.2	10.6	12.7	14.0									14.0	12.6	9.6	8.3
75°	105°	8.0	8.2	10.6	12.7	14.2	15.0								14.7	12.9	9.7	8.4
90°	90°	8.0	8.2	10.6	12.7	14.2	15.1	15.5							15.1	13.1	9.8	8.4
105°	75°	8.0	8.2	10.6	12.7	14.2	15.1	15.6	15.8						15.4	13.4	9.9	8.5
120°	60°	8.0	8.2	10.6	12.7	14.2	15.1	15.6	16.0	16.3					15.5	13.5	10.0	8.5
135°	45°	8.0	8.2	10.6	12.7	14.2	15.1	15.6	16.0	16.4	16.4				15.6	13.6	10.1	8.6
150°	30°	8.0	8.2	10.6	12.7	14.2	15.1	15.6	16.0	16.4	16.4	16.4			15.6	13.6	10.1	8.6
165°	15°	8.0	8.2	10.6	12.7	14.2	15.1	15.6	16.0	16.4	16.4	16.4	16.4		15.6	13.6	10.1	8.6
180°		8.0	8.2	10.6	12.7	14.2	15.1	15.6	16.0	16.4	16.4	16.4	16.4	16.4	15.6	13.6	10.1	8.6

[1] Net tire marks, measured along radial lines of outside circular curve.

TABLE 4

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 75-FOOT OUTSIDE RADIUS

Tangent deflection Δ	Interior angle	Width in feet at various stations[1]																
		BC —50	BC —25	BC	Central angle ahead of BC										Back of EC	EC	EC +25	EC +50
					15°	30°	45°	60°	75°	90°	105°	120°	135°	150° or more	15°			
30°	150°	8.0	8.2	9.8	11.0											10.5	8.8	8.2
45°	135°	8.0	8.2	10.0	11.8										12.3	11.1	9.0	8.2
60°	120°	8.0	8.2	10.0	12.0	13.3									13.2	11.6	9.3	8.2
75°	105°	8.0	8.2	10.0	12.0	13.4	14.1								13.8	11.8	9.3	8.2
90°	90°	8.0	8.2	10.0	12.0	13.4	14.1	14.5							14.1	12.0	9.4	8.3
105°	75°	8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7						14.2	12.1	9.4	8.3
120°	60°	8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7	14.9					14.3	12.1	9.4	8.3
135°	45°	8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7	14.9	14.9				14.3	12.1	9.4	8.3
150°	30°	8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7	14.9	14.9	14.9			14.3	12.1	9.4	8.3
165°	15°	8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7	14.9	14.9	14.9	14.9		14.3	12.1	9.4	8.3
180°		8.0	8.2	10.0	12.0	13.4	14.1	14.5	14.7	14.9	14.9	14.9	14.9	14.9	14.3	12.1	9.4	8.3

[1] Net tire marks, measured along radial lines of outside circular curve.

(2) While it is possible for truck-trailer combinations to turn within a 50-foot radius, it is very difficult, and in tests it was found necessary for the truck to make these turns at speeds of approximately five m.p.h. It is recommended that the minimum outside radius be at least 60 feet, which will allow for a reasonable approach speed.

HOW TO USE THE TABLES

(1) Plate 4 (3-Center Curves)

Normally the given data will include the pavement edges of the approach and leaving tangents, and the angle at which they intersect, or Δ. The designer may then lay lines parallel to these pavement edges, which will represent the opposite lane edges. In *Plate 4*, D-B is the pavement edge of the approach tangent, and E-F is the pavement edge of the leaving tangent. Lines D_0-BC_0 and EC_0-F_0 are laid at lane widths W_1 and W_2 from the pavement edges. W_1 and W_2 will normally be 12 feet, but may be 10 to 14 feet.

TABLE 5

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 100-FOOT OUTSIDE RADIUS

Tangent deflection	Interior angle	Width in feet at various stations[1]																
		BC —50	BC —25	BC	Central angle ahead of BC										Back of EC	EC	EC +25	EC +50
Δ					15°	30	45°	60°	75°	90	105	120°	135	150° or more	15			
30°	150°	8.0	8.0	9.4	10.7											10.1	8.8	8.2
45°	135°	8.0	8.0	9.4	11.3										11.7	10.6	8.9	8.3
60°	120°	8.0	8.0	9.4	11.3	12.2									12.3	10.8	9.0	8.4
75°	105°	8.0	8.0	9.4	11.3	12.2	12.8								12.6	10.9	9.0	8.4
90°	90°	8.0	8.0	9.4	11.3	12.2	12.8	13.0							12.7	10.9	9.0	8.4
105°	75°	8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0						12.7	10.9	9.0	8.4
120°	60°	8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0	13.0					12.7	10.9	9.0	8.4
135°	45°	8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0	13.0	13.0				12.7	10.9	9.0	8.4
150°	30°	8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0	13.0	13.0	13.0			12.7	10.9	9.0	8.4
165°	15°	8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0	13.0	13.0	13.0	13.0		12.7	10.9	9.0	8.4
180°		8.0	8.0	9.4	11.3	12.2	12.8	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.7	10.9	9.0	8.4

[1] Net tire marks, measured along radial lines of outside circular curve.

TABLE 6

TRACTOR TRUCK-SEMITRAILER TRACK WIDTHS, 200-FOOT OUTSIDE RADIUS

Tangent deflection	Interior angle	Width in feet at various stations[1]																
		BC —50	BC —25	BC	Central angle ahead of BC										Back of EC	EC	EC +25	EC +50
Δ					15°	30°	45°	60°	75°	90°	105°	120°	135°	150° or more	15°			
30°	150°	8.0	8.0	8.4	9.6											9.0	8.3	8.2
45°	135°	8.0	8.0	8.4	9.6										9.9	9.1	8.4	8.2
60°	120°	8.0	8.0	8.4	9.6	9.9									9.9	9.1	8.4	8.2
75°	105°	8.0	8.0	8.4	9.6	9.9	9.9								9.9	9.1	8.4	8.2
90°	90°	8.0	8.0	8.4	9.6	9.9	9.9	9.9							9.9	9.1	8.4	8.2
105°	75°	8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9						9.9	9.1	8.4	8.2
120°	60°	8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9	9.9					9.9	9.1	8.4	8.2
135°	45°	8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9	9.9	9.9				9.9	9.1	8.4	8.2
150°	30°	8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9			9.9	9.1	8.4	8.2
165°	15°	8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9		9.9	9.1	8.4	8.2
180°		8.0	8.0	8.4	9.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.1	8.4	8.2

[1] Net tire marks, measured along radial lines of outside circular curve.

A circular curve BC_o-EC_o may be selected which will fit physical controls of the particular plan being designed. The center of the middle curve, C_2, is established at distances e and s from BC_o, and the middle curve is described. Curves C_1 and C_3 are laid tangent to the middle curve and to whatever lines are desired; normally pavement- or lane-edges parallel to the approach and leaving tangents.

Holding the distances e and s constant through a wide range of deltas, as this table does, will cause *the offset from the leaving tangent to vary as the* Δ *changes*. Trouble which has been experienced with symmetrical compound curves has been largely due to trying to fix the location of the middle curve at a constant distance from both tangents regardless of Δ.

In solving the equations for Δ_3 and the semitangents, care must be taken to keep the algebraic signs of the various terms correct. For example, sometimes $(e - R_o)$ will be positive and sometimes negative. Furthermore, with Δ of between 90 degrees and 270 degrees, $\cos \Delta$ will be negative.

(2) Tables 2 to 6 (Track Widths)

For testing previous designs where the radius of the outside edge has

already been determined, or for new design where none of the radii given in *Table 7 (Plate 4)* will fit physical controls, and in designing ramps on structures, the following procedure may be used:

Step 1. Draw lines which represent the path of the outside wheels of the truck in the through road and connecting road. ("Outside" means the side farthest from the center of the curve which is being laid out.)

Step 2. Fit a circular curve tangent to the lines produced in Step 1. The radius of this curve may be chosen to fit physical controls, but must be at least 48 feet, which would allow for a 50-foot radius lane edge.

Step 3. Beginning 50 feet before the BC and ending 50 feet beyond the EC, lay off points at distances from the circular curve and approach tangents which are given in *Tables 2 to 6*. For radii and central angles not given in the tables, these distances may be interpolated.

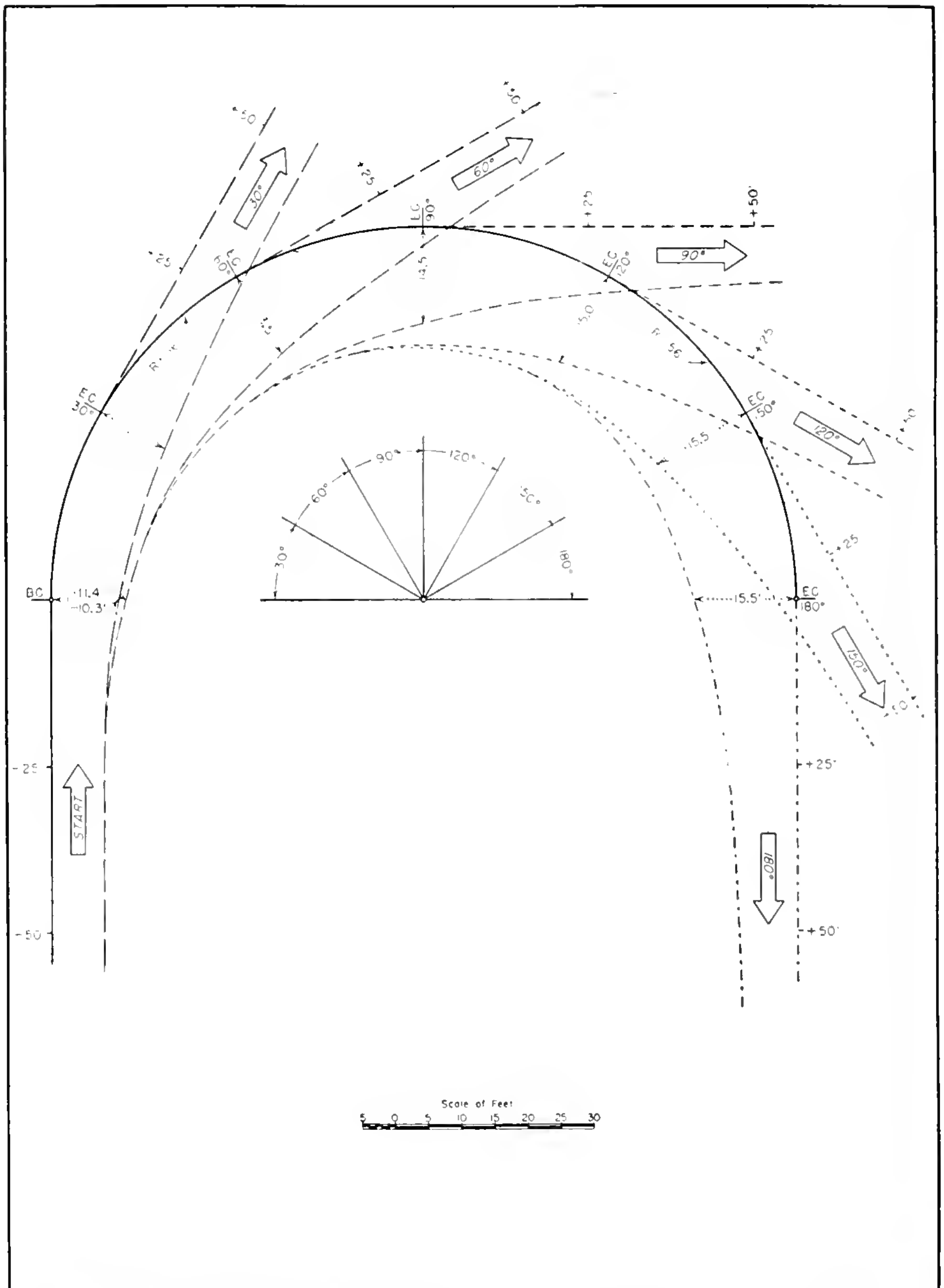
Step 4. (a) Lay a compound curve to fit the plotted points, *being sure to allow leeway*, since the widths given in the tables are neat tire tracks and do not allow for drivers' judgment.

(b) Lay a circular curve around the outside track which has been described in Step 2, allowing similar leeway.

The curves laid in Step 4 may be used for pavement edge, curb lines or island limits, as the case may be.

It is recommended that nothing less than a 60-foot outside radius be used if it is anticipated that the vehicles will be moving at even a nominal rate of speed when they enter the curve.

Templates may be prepared for use as overlays to test certain designs for clearances. *Plate 13* illustrates a possible layout of such templates. It has a scale of 1" = 50'; however, the transparencies can be made to any desired scale. The radii of *Plate 13* were chosen to allow a two-foot clearance between the front wheel and curbs of 50, 60, 67, and 75 feet in radius. The templates can be produced by photographing *Plate 13* (or a tracing of it) and then transferring the image to sensitized acetate film.



Semitrailer Wheel Tracks. 56-ft. Outside Radius **Plate 6**

CONCLUSIONS

1. In making short-radius turns, a tractor-truck-semitrailer combination having legal dimensions describes a track whose width exceeds the track of any other legal vehicle in California.

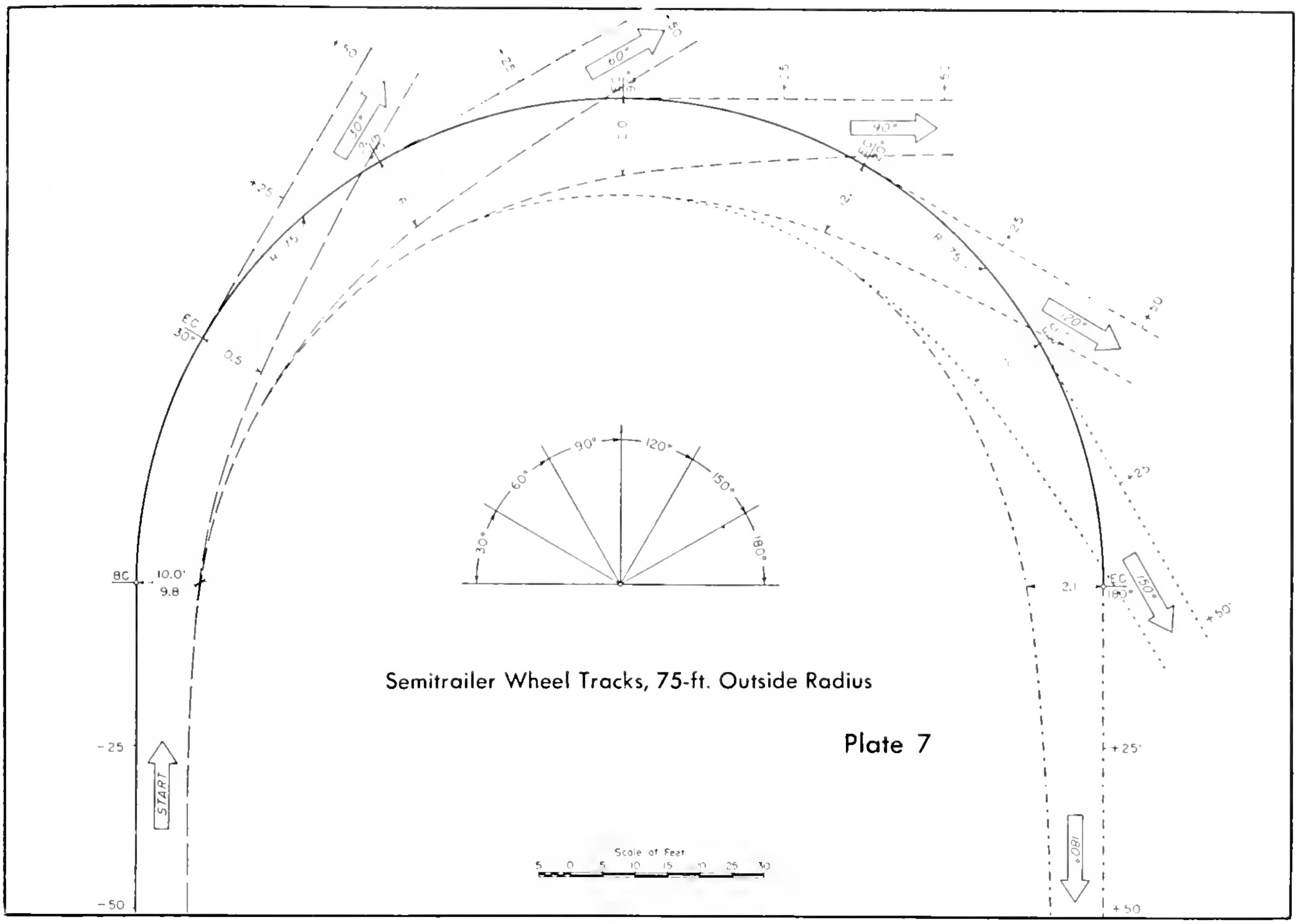
2. The outside track of a vehicle or combination making a short-radius turn at slow speed is a circular curve throughout nearly all of its length and for practical purposes may be considered to be a circular curve connecting the approach and leaving tangents.

3. The sharpest circular curve which can be described by the outside (front) wheel of one legal vehicle is 45 feet. The practical minimum outside radius for turning lanes is 50 feet.

4. All vehicles and combinations, particularly the 3-S2 combination, when making a circular track with the front wheel, produce a spiral track at the rear wheel.

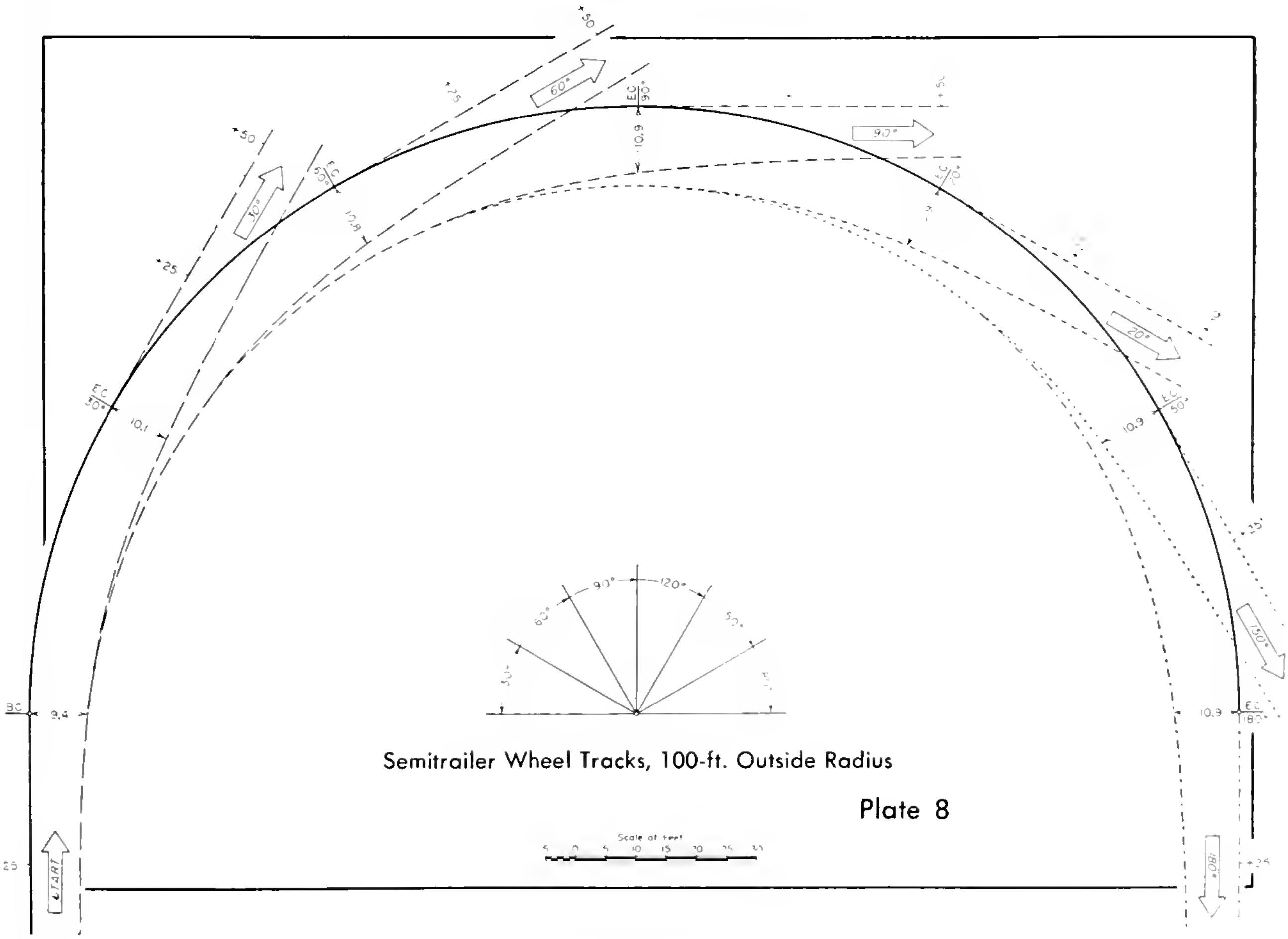
5. The spiral tracks of the rear wheel for left and right turns of equal outside radii are congruent.

6. Track widths for various radii and various central angles are given in Tables 2 to 6. Compound curves which will fit these tracks with recommended leeways are given in *Table 7, Plate 4*. The widths vary from a maximum of 20.2 feet for 50-foot radius curves with 180 degrees of central angle, down to 9.9 feet for 200-foot radius curves with central angles of 45 degrees or more. Standard curve widening for curves of radius greater than 200 feet will amply provide for large vehicles and combinations.



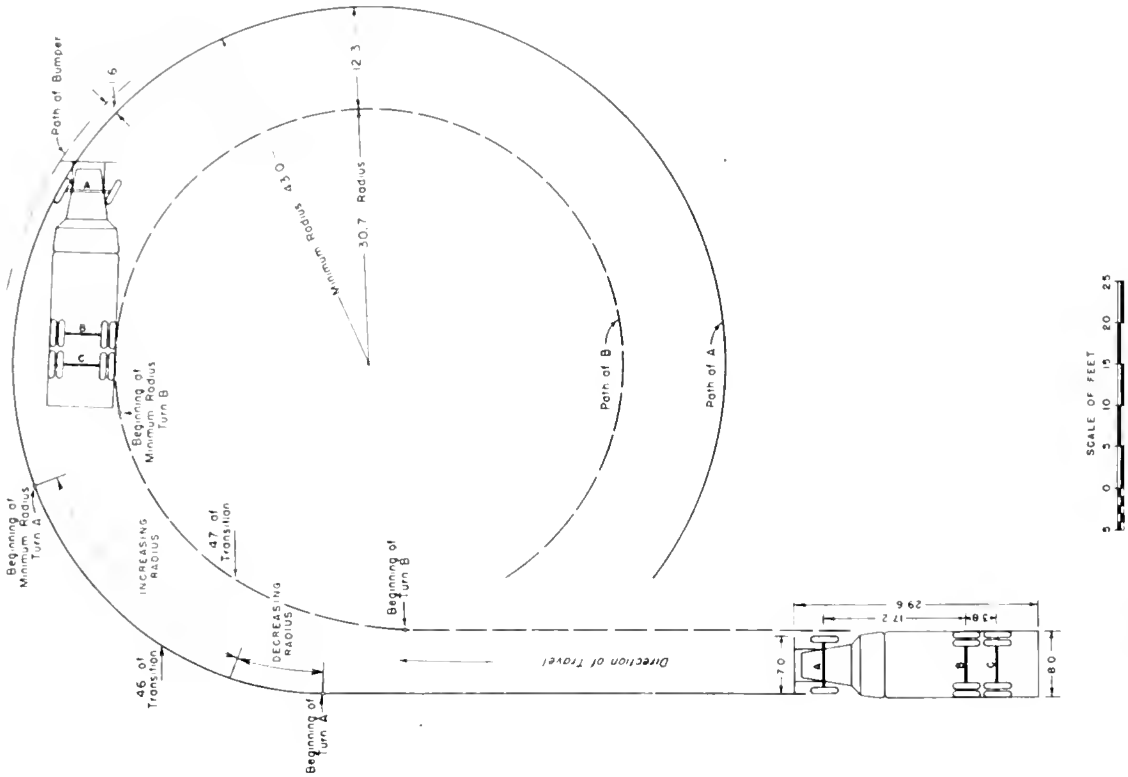
Semitrailer Wheel Tracks, 75-ft. Outside Radius

Plate 7



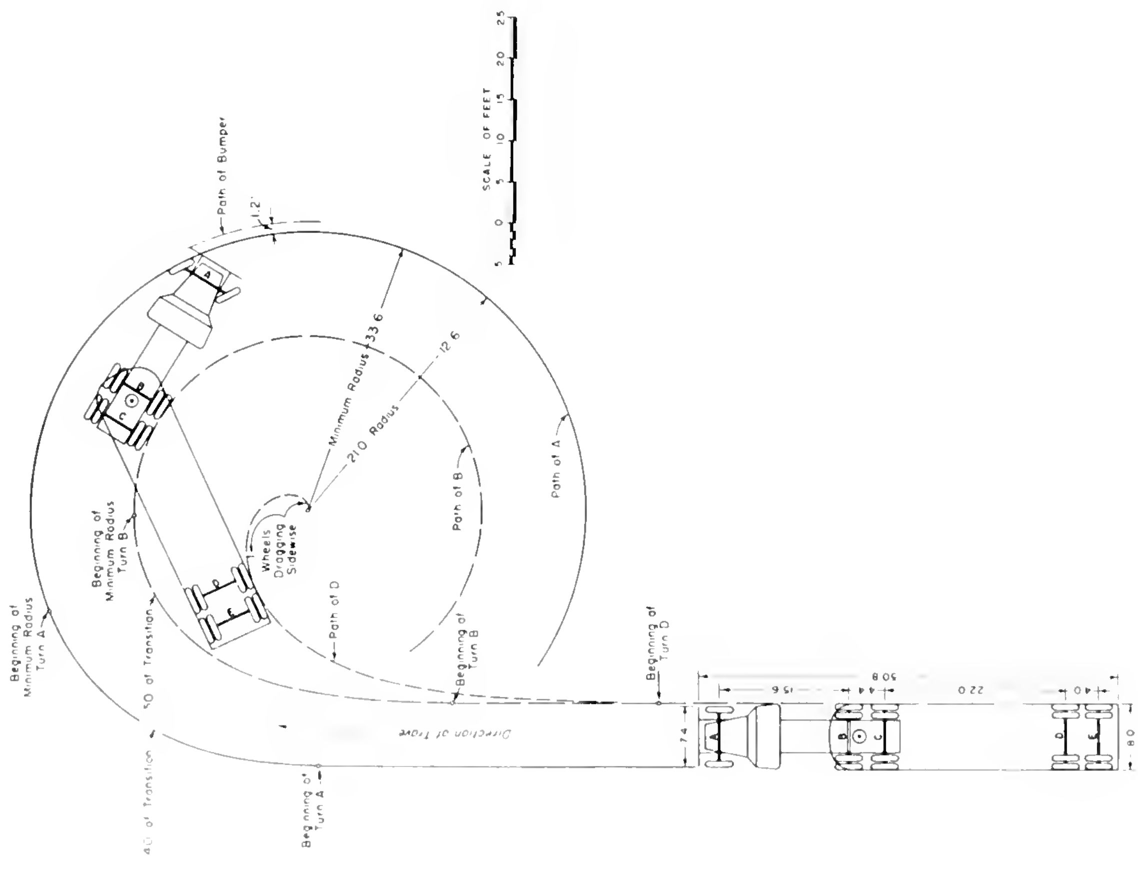
Semitrailer Wheel Tracks, 100-ft. Outside Radius

Plate 8



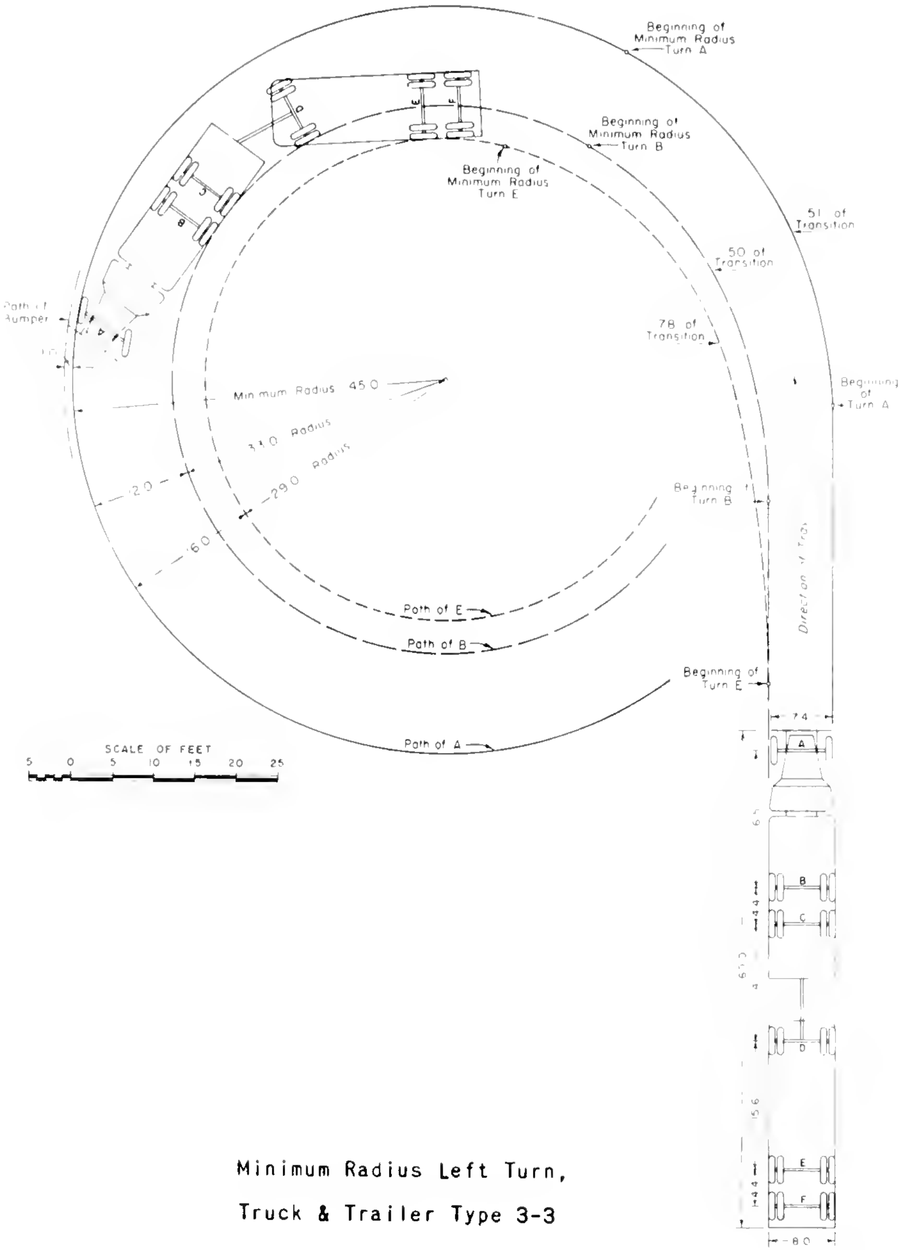
Minimum Radius Right Turn, 3-axle Truck

Plate 9



Minimum Radius Right Turn,
Tractor-truck & Semitrailer Type 3-S2

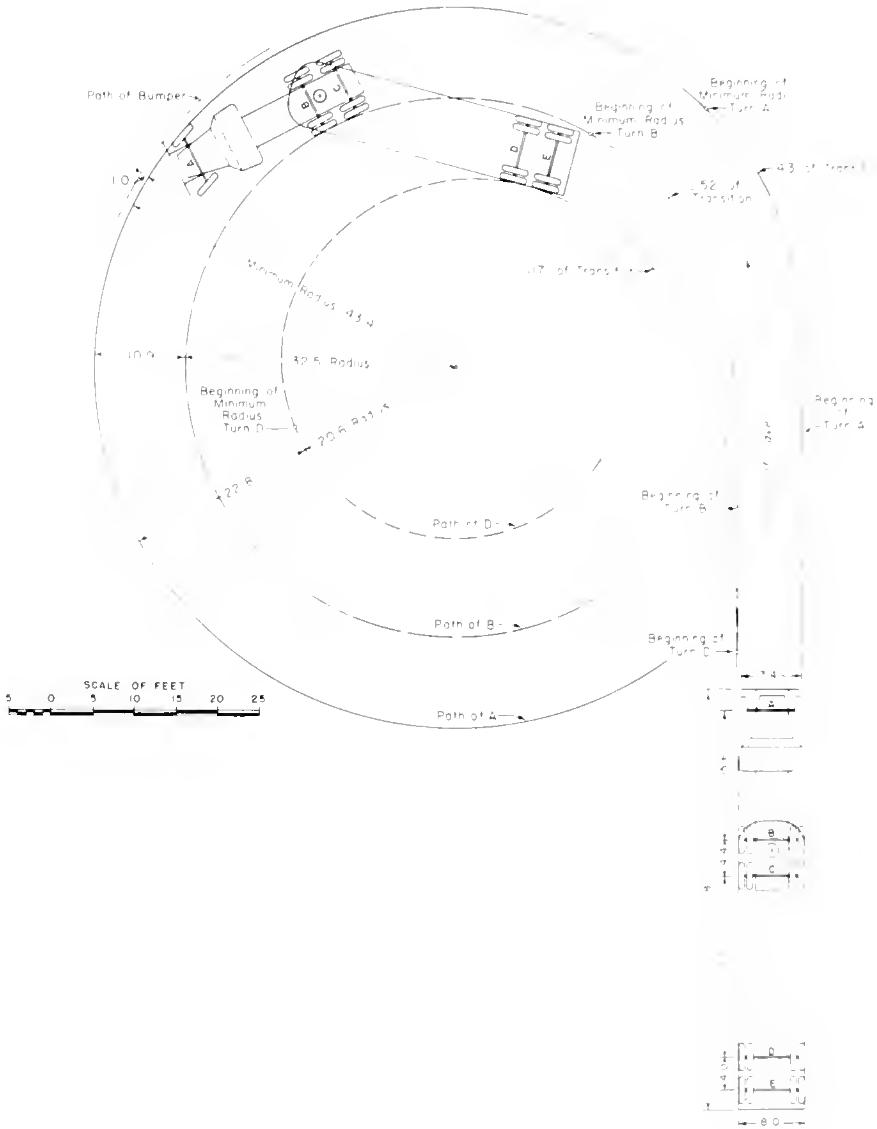
Plate 10



Minimum Radius Left Turn,

Truck & Trailer Type 3-3

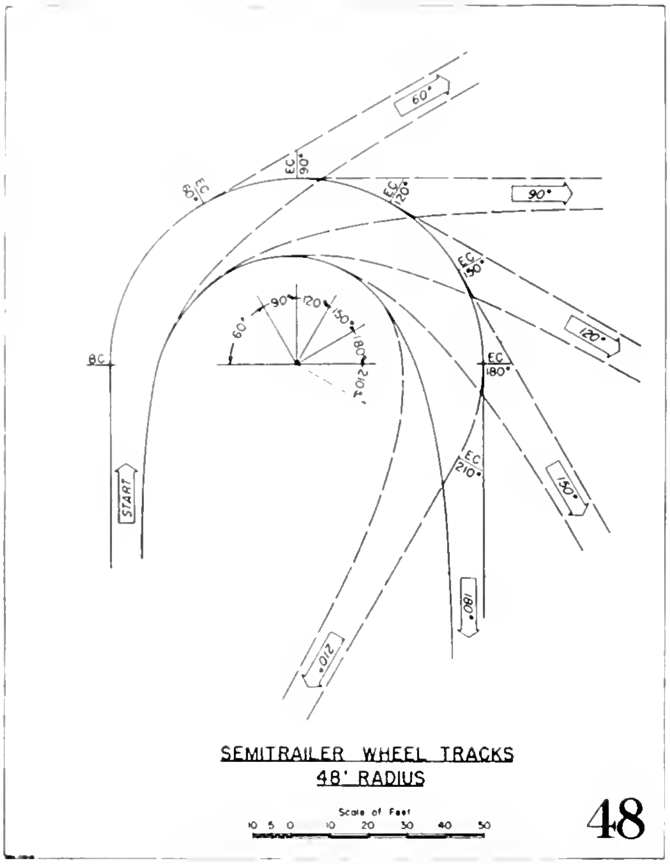
Plate 12

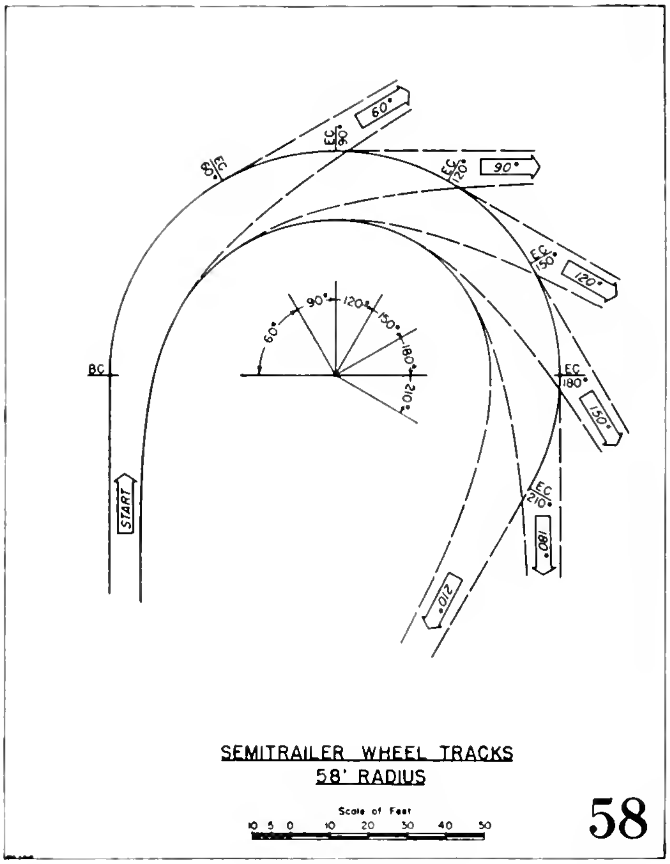


Minimum Radius Left Turn,

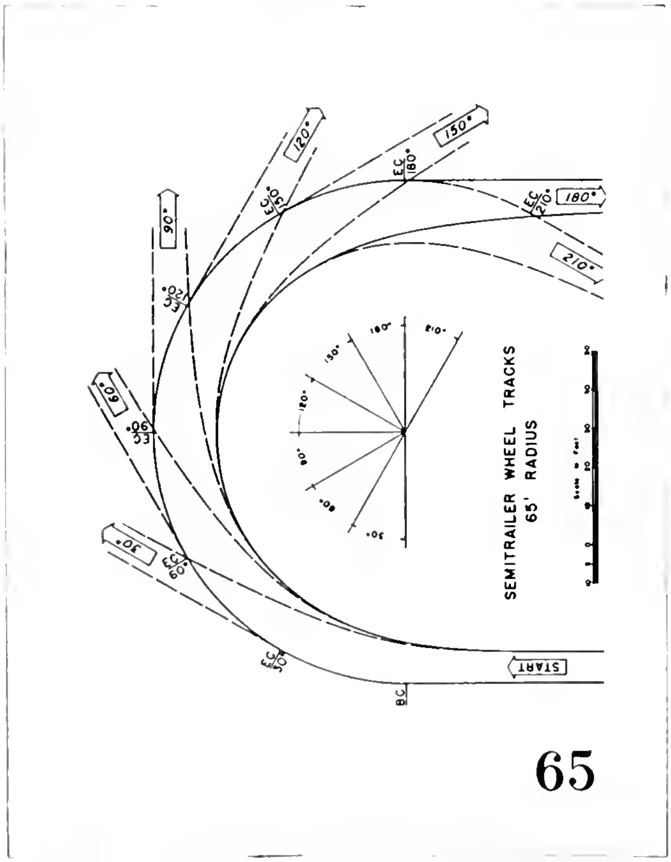
Tractor-truck & Semitrailer Type 3-S2

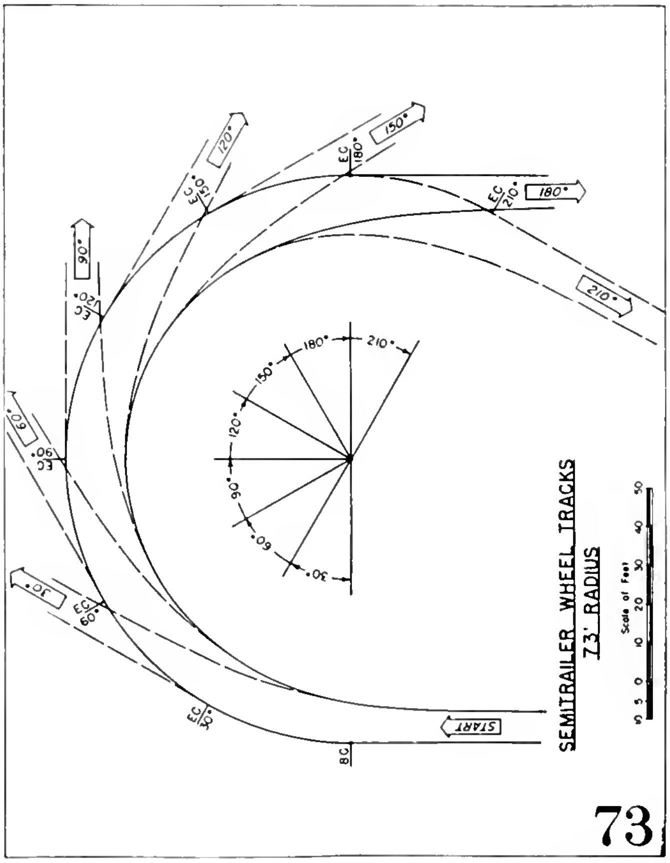
Plate 11





50 SCALE





Templates of Semitrailer Wheel Tracks

Plate 13

TRACK WIDTHS OF EXTRALEGAL AND UNCONVENTIONAL VEHICLES

The California Vehicle Code limits the over-all length of any single unit to 35 feet, and the length of any coupled combination to 60 feet. There are many reasons besides maximum lane widths for these limitations, but at any rate, one effect of the 35-foot limit is to control the lane width used by semitrailers. The amount of off-tracking is a function of the distance from the swivel connection to the rear axle, and as long as the body length is limited, this distance is limited.

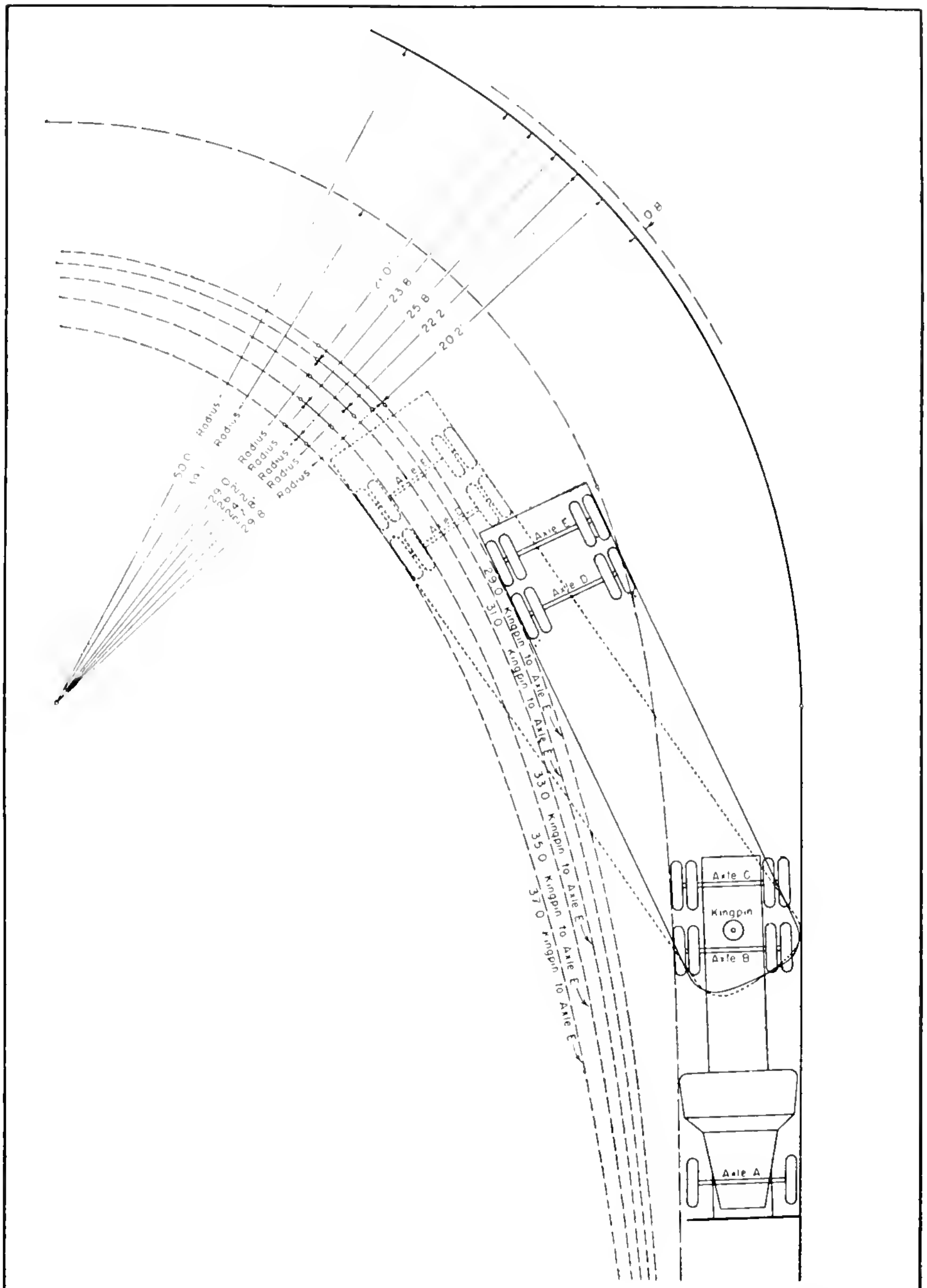
In order to determine what effect the limit on body length *or* wheel base has upon lane width, a semitrailer with conventional 3-axle tractor and 2-axle rear assembly, but with an adjustable length, was tested on the same runs that were made with the van body semitrailer.

It was found that this combination produced a track practically identical to that of the van 3-S2, when the distance from kingpin to rear axle was the same (this distance was 25 feet to the forward rear axle and 29 feet to the rearmost axle).

As the reach pole was lengthened, the track width increased as shown on *Plate 14*. For radii greater than 50 feet, the proportional increase in width was not as great. The approximate relation between additional trailer length and additional track width is shown in *Table 8*, as extracted from *Plate 15*.

TABLE 8

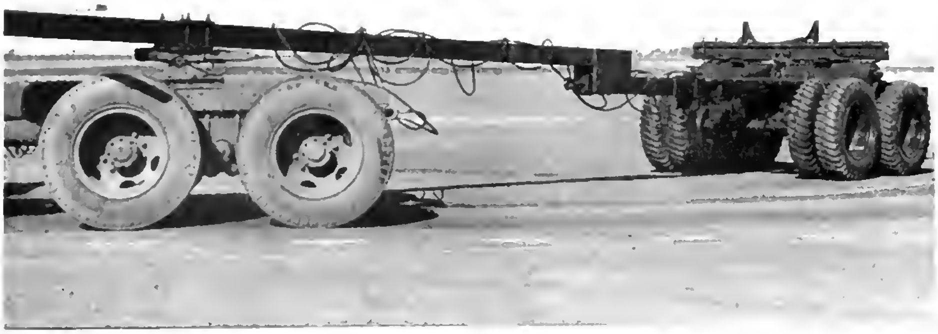
Radius of front wheel track (ft.)	Additional trailer length (ft.)	Additional track width in 180° turns (ft.)
50	2	0.8
	4	2.0
	6	3.6
	8	5.6
75	2	0.8
	4	1.8
	6	2.8
	8	3.8
100	2	0.6
	4	1.2
	6	1.9
	8	2.6
200	2	0.4
	4	0.7
	6	1.1
	8	1.4



Effect of Lengthening Semitrailer — Plate 14

A patented semitrailer named "Monotrailer" was tested on the 53-foot radius turn. As shown in the photograph on the next page, the four rear wheels of this semitrailer are connected to a platform which in itself comprises a sort of full trailer. The van rests on the turntable in the middle of the assembly. The whole assembly assumes an angle with respect to the main van which makes its axis tend to follow the curve of the tractor instead of tending to follow a chord as do the rear axles of a conventional semitrailer.

The comparative tracks of a Monotrailer with a 31-foot reach distance (kingpin to rearmost axle), a semitrailer with a 29-foot reach distance, and a 60-foot truck-trailer are portrayed in *Plate 16*. The track of a conventional semitrailer of the same length is about 4 feet wider.



Extensible semitrailer used in making tests on extra length vehicles

MAXIMUM TRACK WIDTHS ATTAINED IN 180° TURNS OF VARIOUS RADII BY SEMITRAILERS OF SEVERAL LENGTHS

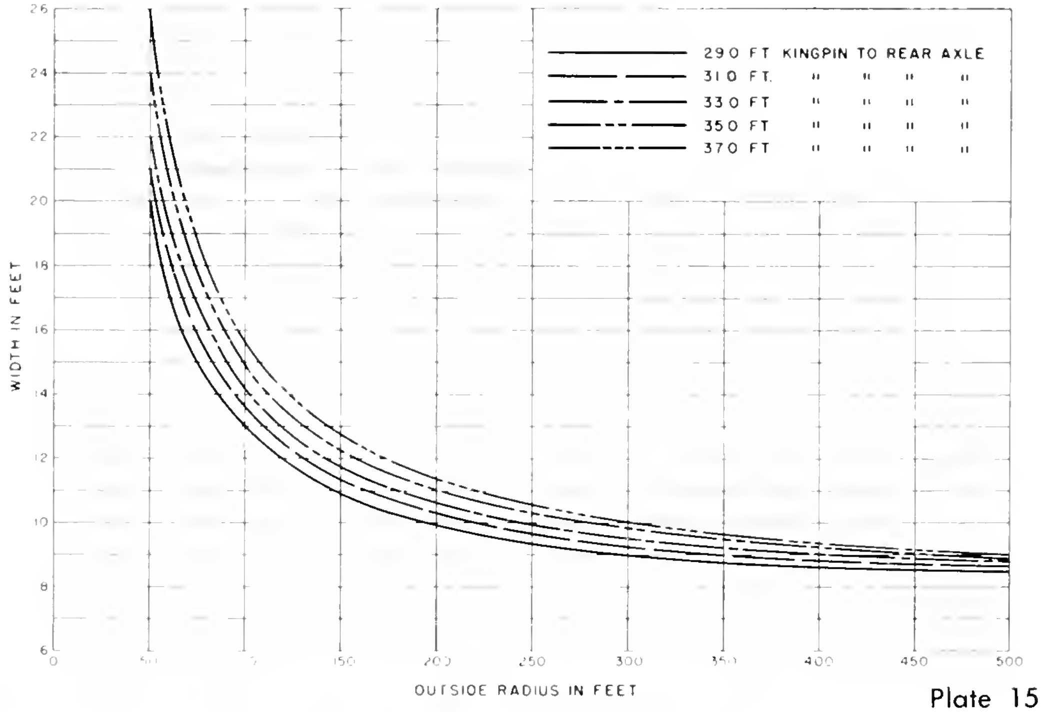


Plate 15

Rear axle assembly of Monotrailer. The tongues form a pantograph, when attached to the main van, which holds the front wheels parallel to the van; while the whole assembly swivels about the turntable on which the van rests

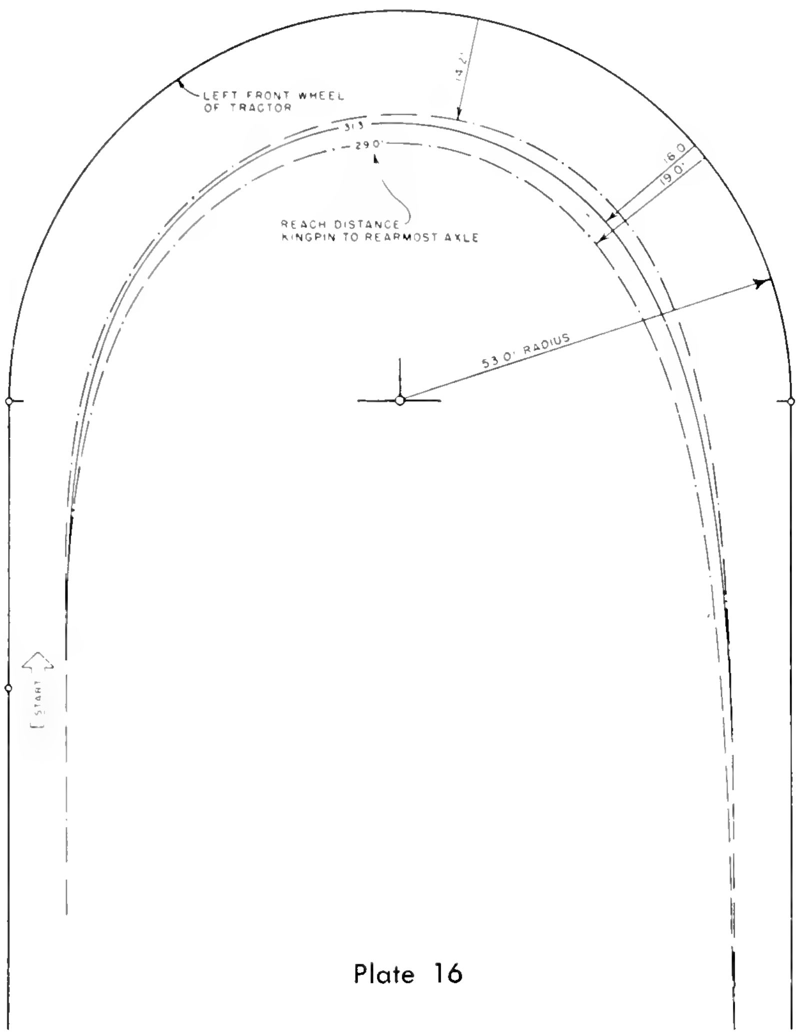


Plate 16

LEGEND

RT REAR WHEEL OF FULL TRAILER (3-3) 20 FT WHEELBASE
RT REAR WHEEL OF ARTICULATED SEMITRAILER 3-AS2, 35 FT BODY
RT REAR WHEEL OF CONVENTIONAL SEMITRAILER 3-S2, 35 FT BODY

Comparison of Articulated and Conventional Semitrailers

Acknowledgments

The work was done under the supervision of the Traffic Engineer of the California Division of Highways, who wishes to acknowledge the cooperation and assistance of:

The Western Highway Institute, a cooperative organization of truck and trailer manufacturers and operating lines.

The Fruehauf Trailer Company, for the accompanying photographs, and the trailers and semitrailers used in most of the tests.

The Sacramento Freight Lines, which supplied the tractor-truck and driver used in many of the tests.

Pacific Intermountain Express, which supplied the tractor-truck and driver used in other tests.

Riske Trucking Company, which supplied the 3-axle truck and 3-axle trailer.

Burton-White Motors, Inc., which supplied the tractor-truck and driver used for the 2-S2-2 tests.

The Aerobody, Incorporated, which supplied the Monotrailer.

The Pacific Greyhound Company, which supplied the bus and driver.

In Memoriam

EDWARD A. WOLFE

The many friends and associates of Mr. Edward A. Wolfe learned with sorrow of his death on Saturday afternoon, February 4, 1950. Mr. Wolfe had served long and faithfully with the Division of Highways, having been Maintenance Superintendent of the Escondido territory in District XI since the formation of the district in 1933.

Mr. Wolfe was born in Iowa in 1884, was graduated from DeWitt High School, and studied engineering at Iowa State College for three years. His experience in engineering for railroads and highways was long and varied. He was employed for 13 years as an engineer in Arizona and New Mexico with the Santa Fe; he was employed in Peru, South America, by the Cerro Pasco Mining Company; in Mexico by the Jalapa Railroad and Power Company; later returned to Arizona, pouring the first concrete bridge foundation for the Santa Fe; then was employed by the Northwestern Pacific south of Eureka, and spent two years in Oregon building and operating a logging railroad.

Mr. Wolfe was a veteran of World War I, having served in France with the famous 23d Engineers. Following his wartime service he returned to Arizona as a construction engineer, and went from there to Los Angeles and to San Diego, where he was employed as a contractor's superintendent.

Then, in 1929, came the beginning of Mr. Wolfe's long and valuable service with the Division of Highways. His early employment with the State was in Districts VIII, VII, V, and IV. Following this he transferred to District XI, where he worked until his death. His experience and ability were always a source of satisfaction and pride to the district and to all who worked with and under him. He retained a fine sense of humor under even the most trying circumstances. All of his many friends and associates extend their sincere sympathy to Mrs. Wolfe and their children, for their loss is our loss, too.

Preston L. Fite Retires After Long Service

HARD ON THE HEELS of the retirement of its chief, T. H. Dennis, maintenance engineer, the Maintenance Department of the Division of Highways lost another of its veterans when Preston L. Fite, Senior Engineer, Sacramento Headquarters, retired on March 31st after 32 years of state service.

Fite had been senior highway engineer since 1931. His duties as assistant to the state maintenance engineer have taken him all over the state.

He came West from his birthplace, Philadelphia, Pennsylvania, in 1906. He and his parents settled in Berkeley soon after the San Francisco earthquake and fire. His family moved to Sacramento in 1911. He attended schools in Sacramento as well as in Philadelphia and Berkeley.

He was employed by the highway department as a helper in the State Testing Laboratory at the age of 18. The laboratory then was located on the State Fairgrounds

Joined Survey Crew

Fite next became a member of a state highway survey crew doing highway location work between Grass Valley, Nevada County, and Auburn, Placer County, and later to Nevada City, Nevada County, in 1916.

In 1917, he enlisted in the Navy and later returned to the Highway Department to work out of Lodi, Stockton, San Joaquin County, on location surveys between those points and Sacramento.

He was transferred to Clarksville in 1919. He was timekeeper and later assistant resident engineer on construction work between White Rock and Shingle Springs.

Fite left California in 1921 to accept a position as resident engineer on a construction project of the North Carolina Highway Department. He went to Mexico in 1925 as District Engineer for the National Commission of Roads of Mexico.

Returned in 1926

He returned to California in 1926 and in the spring of 1927 was employed by the Division of Highways, District 10, with headquarters in Sacramento.

He was active in the organization of the State Employees Association, became the first president of the High Sierra Chapter, is a member of the Elks Lodge, the American Legion, the Masonic Lodge and the Commonwealth Club of San Francisco.

Highway Department officials and employees honored Fite at a retirement party on March 30th.

E. G. Poss Retires After 32 Years' Service With the California Division of Highways

AFTER THIRTY-TWO YEARS of State service, E. G. "Ed" Poss, Assistant District Engineer, District IV of the Division of Highways, retired on January 1, 1950. Immediately thereafter, he left on a month's trip to Mexico where he enjoyed the interesting scenes in the vicinity of Mexico City, as well as the sport of deep sea fishing at Acapulco.

Mr. Poss commenced his engineering career following the Spanish-American War, in which he had seen service. From 1899 to 1918, he was engaged in railroad engineering in Michigan, Tennessee, Florida, and in Mexico, and was also employed by the Northwestern Pacific Railroad as valuation engineer in San Francisco. After this assignment, he chose a career with the Division of Highways, District IV, reporting as Assistant Resident Engineer in March, 1918.

E. G. Poss

During Ed's career in District IV, he served successively as Assistant Resident Engineer, Resident Engineer, District Right of Way Agent, Construction Engineer, Office Engineer, and, finally, as Assistant District Engineer.

Entirely through correspondence courses and diligent self-education, in the early days of his career he had acquired a thorough knowledge of railway and highway engineering principles, and his knowledge, experience, and good judgment were of great value to his fellow employees as well as to other engineers who contacted the district in matters of mutual concern.

Ed Poss enjoyed a large number of friends among his co-workers as well as in agencies outside of the department. He was held in high regard for his unfailingly genial disposition, his sympathetic understanding of the problems of others, and his sincere desire to help whoever turned to him for assistance.

On the evening of March 1, 1950, approximately 120 of Ed's fellow employees gathered at the Tivoli Restaurant in San Francisco to tender him their best wishes upon the occasion of his retirement. He was presented with a number of gifts, most of which were intended to increase his skill as a fisherman, as well as to induce him to pursue this hobby with greater diligence now that sufficient time is available.

Ed's fellow employees are going to miss him around the office but they will be visiting him at his home in the East Oakland hills whenever they wish to reminisce over the "good old days" or to plan some new hunting or fishing venture.

Death Summons Dr. L. I. Hewes, Road Builder

Dr. Laurence Ilsey Hewes, Chief of the Western Regional Office of the Bureau of Public Roads, Department of Commerce, died suddenly in San Francisco on March 2d. He was 74 years old.

Born in Dover, New Hampshire, Dr. Hewes attended Dartmouth College and Yale University, where he earned the degree of Doctor of Philosophy. For 10 years he was an instructor and later professor of mathematics and engineering at Rhode Island College, Yale University and Whitman College.

In 1911 he was employed by the Bureau of Public Roads, at a time when the science of roadbuilding was in its infancy and the needs for modern highways were first being felt. From the beginning, Dr. Hewes has played an important part in highway development, not only in the discharge of his official duties on assignments of great responsibility, but as an original thinker in the uncharted fields through which highway development has advanced.

Authority on Highways

Soon after employment with Public Roads he became Chief of Economics and Maintenance, and was shortly recognized as an authority on highway financing. He was the first to apply systematic procedures in measuring the economic need for highways. With the initiation of federal aid for highways in 1916, Dr. Hewes took an important part in planning the organization's administration and working relations with the states.

Since 1920 he has been in charge of federal aid and national forest road construction in 11 western states, Alaska, and Hawaii. In that capacity he exercised great influence in a large region, and became recognized as an authority on all phases of highway development from the details of design and construction to the broad general policies of planning and economics.

He was chairman of the United States delegation to the International Road Congress held in Munich, Germany, in 1934. In 1946, on leave from Public Roads, he served as engineering consultant to the Government of Saudi Arabia.

Wartime Service

Although he reached retirement age in 1946, his services to the Bureau during the war and postwar periods were so needed that he was requested to carry on, and gladly did so: The progress of his country and its highways were always his primary interest.

Dr. Hewes was a prolific writer, despite his arduous official duties. One of his earliest works, "Highway Bonds," written in collaboration with Professor J. W. Glover in 1915, is still a standard work on the subject. His best-known publication is the two-volume "American Highway Practice," an outstanding textbook for students and engineers alike, published in 1942.

In addition to his numerous bulletins, papers, and speeches in the fields of highway engineering, administration, finance, and economics, he has, in pursuit of his hobbies, written articles on mathematics and biology which have been published in scientific magazines.

Dr. Hewes brought to the highway field an inquiring mind, and a broad education resulting from his studies both within and outside of the field of civil engineering. Always he has been among the leaders in anticipating future needs and in planning to meet them. His own stature has added much to the prestige of Public Roads and of the highway engineering profession generally.

In Memoriam

HARVEY M. TOY

Harvey M. Toy, former Chairman of the California Highway Commission, died in San Francisco on March 1st. His sudden death shocked a host of friends throughout the State.

Financier, owner of a string of hotels and prominent in politics in the 1920's, Mr. Toy was a leader in highway development movements in California for many years. He managed the successful campaign of Friend W. Richardson for Governor in 1922 and was appointed Chairman of the Highway Commission when Richardson assumed office in 1923.

Mr. Toy was a grandson of a 49er. His father, George D. Toy, who died in 1921, amassed a fortune in San Francisco and East Bay real estate and his son increased the family holdings through the purchase of properties in various parts of the State. For years his Manx Hotel on Powell Street in San Francisco was a rendezvous for political leaders and good roads boosters.

Mr. Toy was president of the San Francisco Hotel Association and head of the California Hotelmen's Association. He twice served as president of the California Mission Trails Association. A widow, Juliette E. Toy, a daughter, Mrs. Elizabeth Lassen of Sacramento, and a sister, Mrs. Francis Lucas, survive him.

Texas Reorganizes Highway Department

Complete reorganization of the administrative and executive leadership of the Texas Highway Department modeled after the California Division of Highways, was announced in January by D. C. Greer, State Highway Engineer of Texas.

As in the California Division of Highways, there will be a deputy state highway engineer. Also named are assistant state highway engineers and engineers in charge of planning, construction and maintenance, materials and tests, and road design. In the reorganization, Greer made promotions from the ranks of veteran engineers of his department, as did State Highway Engineer George T. McCoy in revamping the California department.

Pigeon Pass Renamed

Pigeon Pass Road in San Bernardino County, the modernization of which was the subject of an article in the January-February issue of *California Highways and Public Works*, has been officially named Barton Road by the Board of Supervisors of San Bernardino County. The highway was named in honor of Dr. Ben Barton, a pioneer settler, physician, agriculturist, and educator of San Bernardino. His home still stands where he built it on Nevada Street in San Bernardino just north of Barton Road.

Erosion Control

Methods Used on California State Highways Discussed

By H. DANA BOWERS, Supervising Landscape Architect

California, a wrinkled ribbon of land more than 800 miles long lying between the high Sierras and the Pacific Ocean, stretches from the humid forested zone characteristic of the Pacific Northwest to arid northern Mexico, and ranges in elevation from below sea level to more than 14,000 feet. Climatic variations are extreme, as might be expected, and erosion control problems vary correspondingly. Many different types of control have, therefore, been found to be necessary.

The purpose of this series of articles is to discuss the variable factors associated with erosion which affect California roadsides, review the development of erosion control methods by the State Division of Highways, and describe erosion control processes now being employed with reasonable success to stabilize slopes on California state highways. This is the third installment.

It is felt that at least a few of the methods which have proved effective in California may be modified to suit conditions in other regions. Consequently, descriptions have been made as complete and are illustrated as fully as possible in order to permit duplication of these methods by nontechnical personnel.

The erosion problem on agricultural lands is another matter entirely. Since this phase of the subject is adequately treated in publications of the Soil Conservation Service we will consider here only erosion as it directly affects roadsides.

WIND EROSION

When roadway excavations are made through incompletely stabilized sand dunes or the roadway lies in the path of active dunes, wind erosion with the resulting drifting sand becomes a serious problem.

Mechanical methods of control; for example, spraying the sand banks with liquid asphalt, have the advantage of stopping soil movement immediately, but maintenance cost is usually high and increases yearly until finally the original treatment must be repeated. This type of control cannot be considered permanent.

In arid or infertile areas where plant growth is naturally sparse and rock or gravel is plentiful, some form of the mechanical method of control illustrated below may be utilized. The cost of hand placing rock in this manner is high, but this expense may be justified under extreme conditions. A blanket of coarse gravel is also reasonably effective when conditions are not favorable for vegetative growth.

Vegetative Stabilization

Vegetative stabilization of areas subject to wind erosion is both practical and inexpensive. A topsoil blanket, supplemented by seeding, is often sufficient to stop soil loss. If no topsoil is available, seeding, followed by application of a straw mulch worked into the

UPPER—Wind erosion affects both the sandy cut slope and the traveled way. (Near Carmel, Monterey County.) LOWER—Rock placed by hand on sandy cut slope face, controls wind erosion in desert areas. (Near Little Lake, Inyo County)

soil with a sheepsfoot roller is usually effective. In extreme cases where the soil is very loose and the wind velocity high, seeding followed by application of a layer of cut brush will give control.

With any of these methods, the function of the humus, mulch or brush is largely to suppress movement of the soil until plants have become established, after which the vegetation alone gives adequate protection.

Moving sand dunes which threaten to overwhelm a highway may be stopped in their tracks by making use of the beach grass which John McLaren found so effective when he reclaimed dune country and transformed wasteland into Golden Gate Park in San Francisco.

A sandy slope, completely stabilized with cut brush and European Beach Grass (Near Pescadero, San Mateo County)

European Beach Grass interplanted with Italian Ryegrass controls wind erosion on a sandy slope. (North of Eureka, Mendocino County)

Barley and weeds growing on a recently stabilized slope. (Near Monterey, Monterey County)

European Beach Grass

European beach grass (*Ammophila arenarial*), a perennial grass with long creeping rootstalks, is one of the world's best sand-binders. It is propagated readily by division, and once established forms clumps which discourage further movement of sand.

Planting is usually done in the late fall when continued rainfall in sufficient quantities to establish plant growth may be expected. A mulch of cut brush or straw may be spread over the area to be stabilized in order to stop movement of sand until vegetation becomes established. Divisions of beach grass are then planted through the mulch into moist sand to a depth of about eight inches. If sufficient moisture continues to be available, growth is reasonably rapid, and by the end of the first season the stand of beach grass is usually sufficiently dense to afford effective control.

If sand movement is not too vigorous, the mulch treatment is often not necessary. Divisions of beach grass may be planted in the sand, and if this planting is supplemented by seeding with Italian ryegrass or a cereal grain, satisfactory control may be obtained.

SEEDING AND GROUND COVER PLANTING

Records left by early-day explorers and missionaries indicate that in their time wildflowers covered the State of California from one end to the other. Few of the annuals and perennials now

livestock, and these must be eradicated on highway rights of way in agricultural areas. Consultation with the local county agricultural commissioner in regard to weed control and seed quarantine regulations is advisable before sowing seed of untested plants in order to avoid introduction of still another pest which would add to our weed control list.

Trial plantings of many varieties of grasses and forage plants have been made for soil stabilization purposes, but for the most part results have been unsatisfactory.

A well-vegetated cut slope. Native shrubs are rapidly becoming established. (Near Watsonville, Santa Cruz County)

referred to as native because they have made themselves so thoroughly at home here, had as yet been introduced. Rapidly, however, seeds of new plants were brought in—some as impurities in crop seed, some in the wool or hair of imported animals, some in ship ballast, and some deliberately for forage or agricultural purposes. Finding the climate and soil to their liking, hundreds of these introduced plants became naturalized, and the more aggressive among them literally crowded out the true natives.

The point has now been reached where introduced plants make up the greater part of our herbaceous vegetation. Among these naturalized plants are a number which have been declared noxious weeds because of their growth habits, spiny or prickly nature, difficulty of control, or poisonous effect on

A roadside planting of Mesembryanthemum edule effectively controls weeds and reduces the fire hazard. (South of Santa Maria)

Perennials Unsatisfactory

Perennials are often difficult to establish and, even though a good stand may be obtained, too few plants usually survive the summer drought to provide effective protection the following year. With the exception of Italian ryegrass, also called annual ryegrass *(Lolium multiflorum)*, which grows as a short-lived perennial and naturalizes well along the north seacoast, and alfalfa, which persists in a few locations where conditions are to its liking, the perennials so far tested offer no advantages which would prove them superior to annuals for our purpose.

Bermuda grass is extremely effective for soil stabilization in milder sections of the State, but it reseeds so freely and is so difficult to eradicate when once established that it has become a serious agricultural problem in Southern California and the Central Valleys. Public reaction to its use in general highway

Willows planted in moist areas assist in stabilization. (Near Watsonville, Santa Cruz County)

planting would be immediate and unfavorable. Consequently, Bermuda seed is planted only in localities where the grass is already so thoroughly established that further planting cannot be considered the introduction of a weed pest.

Annuals Not Effective

Annuals are usually effective during the first year but, except for a very few varieties in favored locations, do not seem to reseed themselves well. Native annuals eventually take over anyway, and since they will offer adequate protection when once established, the naturalization of introduced annuals is not considered too important.

If it were possible to economically obtain seed of the native annuals through commercial channels, a more rapid establishment of a permanent cover could possibly be obtained by sowing this seed during the first year. Neither the quantity of seed available nor the cost makes this procedure practicable, however, since annuals of the type most valuable for stabilization purposes are not useful otherwise, and seed is not harvested commercially.

The conclusion has been reached that almost any annual plant, seed of which is cheap, easy to obtain, and germinates quickly with the first fall rains, will act as a nurse crop and afford adequate and immediate protection. During first year, and to a greater extent the second year, natives appear, germinating from seeds present in the topsoil or from windblown seeds which have been caught and held by the stalks and stubble of the nurse crop. A sparse growth of the introduced annual will probably volunteer the second year, and the protection given by the combination of growing plants, root mats and straw remaining from the previous season's growth, is usually complete.

UPPER—Planting small Eucalyptus rostrata in plant band. LOWER—Growth obtained 28 months after planting. (Between Colton and Ontario, Riverside County)

Growth made by Baccharis viminea four months after planting as cuttings. (City Creek Road, San Bernardino County)

Barley Widely Used

Since barley is harvested in many sections of the State, is about the cheapest seed on the local market, is easily obtainable, and has the virtue of germinating quickly after a light rain even when not covered by earth, it has been most frequently used for stabilization planting. Rye grain, oats, and vetch have also been used successfully.

Grain seed is usually sown broadcast on the rough and uncompacted surfaces of the freshly made or topsoiled slopes,

Dry vegetation means that fire hazard is high. (Near Bradley, Monterey County)

and harrowing or dragging the soil to cover the seed under these conditions has not proved necessary. In the event rain falls before seeding can be done, it is necessary that the slope be cultivated to loosen the surface. Barley and other large-size cereal grains are sown at the rate of one pound per 200 square feet, a considerably heavier rate than that used by a farmer when seeding for grain production.

Quantities of wildflower seed have been sown on highway roadsides for purely ornamental purposes, but this practice has been largely abandoned except on recently completed freeways where sprinkling systems are installed. The successful establishment of a good stand of wildflowers from seed is so dependent upon rainfall conditions in unirrigated areas and the cost of the seed is so relatively high that it is difficult to consistently show results justifying the expenditures.

Poppies Not Lasting

When a roadside project is completed at the proper time of year, California poppy seed is often sown on the new slopes. Given an even start with the weeds and grasses, the poppies will generally grow in sufficient quantity to give a colorful appearance the first season, but slowly disappear thereafter except in rare instances.

Seeds and shrubs and trees have been sown on treated slopes with some success. Spanish broom *(Spartium junceum)*, California wild buckwheat *(Eriogonum fasciculatum)*, silvergreen wattle *(Acacia decurrens dealbata)*, *Encelia californica*, and plume albizzia *(Albizzia lophantha)* seem to germinate well, since seed is easily gathered from established stands, some use has been made of these plants.

The selection of evergreen ground cover plants for unirrigated areas is extremely restricted. Ice plant or Hottentot fig *(Mesembryanthemum edule)* is most frequently used along the coast and is very nearly the ideal ground cover plant, since it spreads by runners which root at every node, makes a dense mat which discourages weeds, is not a fire hazard, is propagated cheaply and easily by cuttings which root in from 5 to 10 days, bears attractive flowers, is drought resistant, and is not seriously affected by pests or diseases. It does not spread by seed, and is very effective in controlling erosion.

Ice Plant Use Restricted

Established stands of ice plant growing in soils of low fertility tend to die out or become unthrifty after several years. When this condition is not due to lack of soil moisture following a dry season, these patches may be rejuvenated with an application of fertilizer followed by replanting with fresh cuttings.

Since the succulent leaves of ice plant are composed largely of water, the plant cannot be grown successfully in areas where the temperature falls much below the freezing point. This restricts its use in the State to the milder sections where the temperature never falls below about 25 degrees F., and to that point only for short periods.

Other smaller-leaved members of the mesembryanthemum family are slightly more resistant to frost, but do not spread so rapidly as *mesembryanthemum edule*.

Kikuyu grass *(Pennisetum clandestinum)* has been used as a lawn, and experimental plantings have been made throughout the State. In areas which are subirrigated or which can be given water during the summer, kikuyu grass does quite well. However, it freezes completely back in colder sections and is regarded by suspicion by county agricultural commissioners, who distrust its lusty growth when once established in irrigated districts, and consider that it might become an agricultural pest if widely planted.

Fire-hazard-control strip formed by the "spray and burn" method. Note the quantity of unburned stems left on the slope after a quick burn. (Near Castroville)

Successful Plants

Ground cover establishment on freeway slopes and other areas equipped with sprinkling systems is comparatively simple. The following is a list of plants which do not require routine mowing or cutting back and which have been used successfully for this purpose.

SOUTHERN CALIFORNIA

Lantana sellowiana	Trailing Lantana
Lonicera japonica halliana	Halls Japanese Honeysuckle
Hedera helix	English Ivy
Vinca major	Bigleaf Periwinkle
Vinca minor	Common Periwinkle
Ipomaea leari	Dawnflower Morningglory
Fragaria chiloensis	Chiloe Strawberry
Mesembryanthemum—many species	Ice Plant, Figmarigold

NORTHERN CALIFORNIA AND CENTRAL VALLEY

Lonicera japonica halliana	Halls Japanese Honeysuckle
Rosa wichuraiana	Wichura Rose
Rubus ulmifolius inermis	Evergreen Thornless Blackberry
Hedera helix	English Ivy
Vinca major	Bigleaf Periwinkle
Vinca minor	Common Periwinkle
Hypericum calycinum	Aaronsbeard St. Johnswort
Gazania aurantiaca	Gazania

TREE AND SHRUB PLANTING

Since most of the trees and shrubs planted on highway roadsides are evergreens, they are raised in and planted from containers. Practically no balling is practiced, since the cost of handling and planting balled stock is considerably greater than with stock in containers.

One-year-old plants in one-gallon cans are planted preferably at the start of the rainy season, mulched, and watered during the first summer, then left to themselves except in the very arid regions where they must be watered until well established.

The cheapest and so far the most effective method found for establishing plants in the field consists of planting very young plants in plant bands. Plants from seed started in July are pricked out into 2 inch x 2 inch x 4 inch wooden plant bands set in a nursery flat. By October or November, roots have grown to the bottom of the band, and the plants, 2 inches to 4 inches high, are ready to be set out. In the field, a hole is dug just large enough to take the plant band and the bottom of the hole is flattened and firmed with a wooden block so that air pockets will be eliminated and roots at the bottom of the band will contact the soil evenly. The plant, band and all, is set carefully into the hole, and moist soil firmed gently around it to the level of the soil inside the band. A small quantity of water is then used to settle the earth and moisten the root area, a mulch of straw or manure is applied, and the plant normally receives no further attention. A survival rate of 80 percent is not uncommon.

Fire-hazard-control strip formed by the soil sterilization method. Note beginning of soil loss on slope which had previously been stable. (Near Paso Robles, San Luis Obispo County)

Distinct Advantages

This method has several distinct advantages. The cost of raising the plants, transportation and planting is considerably less than for larger plants; therefore, many more plants can be planted. Maintenance cost is reduced or eliminated, since the small plants grow like seedlings and require no staking or trimming. Any plants which die can be replaced the following planting season for less money than it would take to water them during the summer. Since root development has not been restricted while in the plant band, normal root growth takes place in the soil outside the band almost immediately after planting. The planting operation involves no disturbance of the root system; therefore, the plant is not set back and growth continues without a pause.

Several precautions must be observed when handling planting stock in bands. The young plants should be planted as soon as the roots appear at the bottom of the band. If planted sooner the roots are dependent entirely upon the moisture contained in the soil within the band itself, and since lateral penetration of moisture through the wooden-band walls seems to be very slow, soil surrounding the roots within the band dries out rather quickly and the plant suffers. If planting is too long postponed after the roots appear at the bottom of the band, the plant is likely to become stunted or suffer a setback when roots are broken during removal of the band from the flat, and the natural tendency of the roots to grow downward may be discouraged. Earth must be moist and firmed evenly in the bottom of the planting hole in order that the roots may penetrate immediately and draw moisture from the outside soil. If moisture conditions in the soil surrounding the plant band are favorable, the plant requires no further watering.

Nursery operations must be closely coordinated with field planting operations in order to insure that plants are planted when the roots are in the proper stage of development. If plants are growing vigorously, this period lasts no longer than two or three weeks.

Plant Bands

Plants which have been handled successfully in plant bands include:

Eucalyptus—many species	Eucalyptus
Eriogonum arborescens	California Buckwheat / Island Eriogonum
fasciculatum	Flattop Eriogonum
Acacia longifolia	Sydney Acacia
dealbata	Silvergreen-Wattle Acacia
pycnantha	Goldenwattle Acacia
Photinia arbutifolia	Toyon, Christmasberry

Gullies formed in a topsoiled slope by successive rains will increase in depth unless treated with straw. (North of Santa Barbara)

Rhus laurina	Laurel Sumac
Hedera helix (as established cuttings)	English Ivy
Lonicera japonica halliana	Halls Japanese Honeysuckle
Spartium junceum	Spanish Broom, Weaversbroom
Baccharis pilularis	Chaparral Broom, Kidneywort Baccharis
Lavatera assurgentiflora	California Treemallow

and many others.

Cuttings of any of the many species of willow are planted in wet or seepage areas, where the roots tend to restrict movement of saturated soil, and the moisture transpired by the leaves helps to dispose of surplus water.

Baccharis viminea cuttings are frequently planted on fill slopes in the mountains of Southern California where storms of high intensity make elaborate erosion control measures necessary. These cuttings 18 inches to 24 inches long and from ⅜ inch to 1 inch in diameter, are made in the late fall and early spring of the year and are planted right-end-up in moist soil as deeply as possible, preferably with only 3 inches or 4 inches of the cutting left exposed. If the soil is hard, a slender bar must be used to form the planting hole in advance of placing the cutting; but if the soil is saturated, the cutting may be thrust into the wet bank to the proper depth without damaging buds or bark. Roots are formed within a few weeks, and the plant makes a remarkable growth, sometimes sending up shoots 6 feet to 8 feet high the year following planting.

FIRE HAZARDS AND EROSION CONTROL

Since the long dry summer season in California is unfavorable for the growth of perennials, most of the herbaceous vegetation found along our roadsides is annual in habit. Annual grasses predominate, and since these grasses die down in early summer when the soil moisture is exhausted, a mat of dry vegetation is formed which is extremely inflammable. A carelessly thrown cigarette or match, glowing bits of carbon from a faulty muffler, or even sunlight shining thorugh a discarded bottle or bit of broken glass may start a fire which can do considerable damage.

The consequences of a roadside fire are often serious. Not only are trees and brush damaged or destroyed on the highway right of way, but adjoining crops, pasture or forested land may be burned. Smoke blowing across the traveled way may cause serious traffic accidents. Accelerated loss of soil due to the destruction of the protective vegetation may be expected during the following rainy season.

State Responsibility

The principle has been well established that the State is not responsible for damage caused to adjacent property by accidental fires started on highway right of way, but a certain moral obligation to the public is recognized. In line with this obligation, and often at the request of federal and state agencies, the State undertakes certain fire-hazard-control work, which is essentially the establishment of a control strip of growth-free soil as near to the maintained roadside shoulder as physical conditions permit. This strip, from three to six feet or more in width, may be established either by mechanical methods (disk or grader), or by spraying and burning before surrounding grass will burn (diesel oil), or by soil sterilization (sodium chlorate or chlorate-borate).

It is apparent that if a strip of soil on cut banks or fill slopes is denuded of vegetation, it will be acted upon by the erosive forces of wind and water. Some soil loss is probable. A decision must be made, therefore, as to which is more important: The potential damage which could be caused by a roadside fire which may never start or which might not be controlled by a strip firebreak, or the more certain but less spectacular loss of soil with its attendant maintenance problems. It is a difficult decision to make, since only probabilities are involved, and no one can be certain where or when fires will start or predict the intensity of the rains.

Spray and Burn Method

From an erosion control standpoint, and accepting the fire-hazard-control strip as a more or less necessary evil, the "spray and burn" method of denuding the strip seems preferable to soil sterilization. If this method is used, vegetation grows in the strip during the winter season and offers some protection to the slope during the rains. Early in summer before the annuals have died, the strip is sprayed with diesel or an inflammable weed oil high in aromatics, then above-ground growth is burned. The root mat remains below the surface of the soil, and assists in stabilizing the slope until fall rains start the cycle anew.

Soil sterilization on cut and fill slopes, on the other hand, results in year-round suppression of plant growth with resultant lack of protection to the slope at any season. This method has the advantage of remaining effective for several years after application, which means a lower yearly cost for treatment, but slopes so treated show a progressively greater soil loss than slopes which are sprayed and burned. Soil sterilization certainly has a place in

suppression of plant growth immediately around guide posts and guard rails and in flat areas not subject to erosion, but should be used very judiciously on slopes which may erode.

Mechanical Methods

Mechanical methods of establishing the control strip seldom complicate the erosion control problem, since equipment can operate efficiently only on relatively flat areas, and slopes are usually not disturbed.

Erosion control treatment of newly formed slopes which involves the use of a straw mulch admittedly increases the fire hazard, but the probability of soil loss is so much greater than the possibility of fire damage that the risk is considered justified. Many miles of new highways bordered by straw-covered slopes have been used by the public for the last several years with remarkably little loss due to fire. It is only after the new slopes have become reasonably well stabilized that establishment of a control strip is considered.

Science may one day discover a fireproofing chemical which will be so cheap and so easily applied that it will be practical for roadside use. Unsightly burned strips would then never mar the scenery, and the slight but inevitable differences of opinion between the erosion-minded and the fire-hazard-conscious agencies would be a thing of the past.

MAINTENANCE OF EROSION CONTROL WORK

There is a certain tendency among highway maintenance crews to consider that slope stabilization treatment applied during construction will adequately protect the slopes without further attention. Unfortunately, this is not the case. No form of vegetative erosion control has yet been found which is so effective that some degree of follow-up treatment does not prove to be necessary before the slope can be considered completely stabilized.

The function which a straw covering performs is to restrict or prevent movement of soil particles. As long as no soil particles are moved, rills or gullies cannot form on a well smoothed slope. Lacking rills or gullies, runoff water is not concentrated in a single channel, but moves slowly and evenly to the bottom of the slope.

Damage caused by runoff water from adjacent property. (Near Goleta, Santa Barbara County)

Once the surface protection of straw is broken, however, soil particles move and small rills form. These rills intersect and form small gullies, which, in turn, act as tributaries to larger gullies, and so on. As the depth of the gullies increases, the area from which they gather runoff water also increases, and the volume of water which appears in the largest gully of a developed system during a light rain is often surprisingly great.

Frequent Inspection

It is obvious, then, that any break in the straw covering must be repaired before soil movement begins in order to take advantage of the protection which the straw blanket is capable of giving.

Frequent inspections, especially during the critical first year, must be given the treated slopes. A sharp lookout must be kept for developing gullies, and additional straw spread in the critical areas before the gullies develop to the point where they become serious. Far better control may be obtained by using a flake of straw at the right time—while the gully is still small—than by using several tons of straw after the damage has been done. Supplementary seeding of weak areas must be carried out if it is apparent that the original seeding is not giving the protection desired. Cuttings of willow or *Baccharis viminea* should be planted in moist or unstable locations in order to dissipate excessive moisture or to assist in stabilizing potential slide areas. If the straw covering has been disturbed by fire or animals or by some other means, it must be replaced in order that the surface protection may continue to be effective.

Constant Vigilance

It goes without saying that constant vigilance is necessary in order to prevent streams of runoff water from above from running over the slope face. Clogged culverts or broken or inadequate berms or intercepting ditches may allow a concentrated stream of water to pour down over the slope, forming large gullies very rapidly. Surface protection is of no value, in this event, and gullies of this type often endanger the roadway itself.

Disposal of sloughed material which must be removed from gutters and shoulders presents a very real problem. If this material is dumped over stabilized slopes in order to get it out of sight or out of the way in the simplest possible manner, the stabilization treatment is then rendered worthless, since gullies forming in the dumped material cut through the buried stabilized surface in a comparatively short time. The effect of this erosion carries on to the very bottom of the slope, and sometimes beyond, since deposited eroded material helps to concentrate runoff water in a definite channel. Furthermore, dumping on a slope which has been planted to shrubs and trees effectively contributes to the failure of the planting, and the consequent loss of the

. . . Continued on page 59

Alvarado Canyon

San Diego Completes FAS Limited Freeway

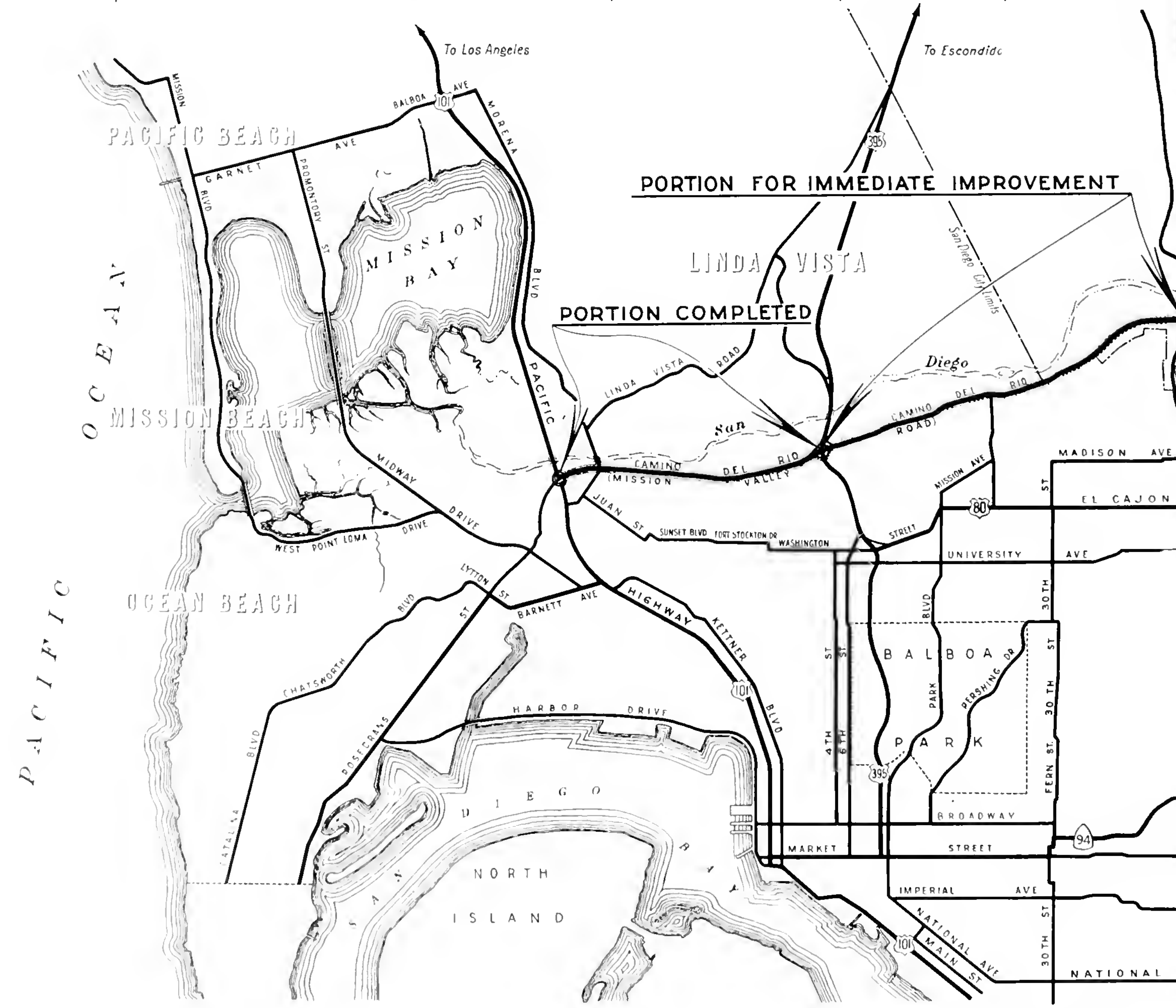
By JOSEPH H. MACK, County Road Commissioner

On January 21, 1950, the easterly 5.09 miles of Federal Aid Secondary Route 732 was officially dedicated and opened to traffic in San Diego County.

This section of FAS Route 732 is locally known as the Alvarado Canyon Road and connects the City of La Mesa at U. S. Highway 80 with the Mission Valley Road at the junction of Fairmount Avenue Extension and FAS Route 731. The Mission Valley Road Section of FAS Route 732 is 3.75 miles long and will soon be under contract, which will complete the improvement of the total length of the route between U. S. Highway 80 and U. S. 395.

This Federal Aid Secondary Route serves the El Cajon-La Mesa area of San Diego County as a limited access highway which by-passes the heavily con-

The map below indicates the over-all importance of the Mission Valley-Alvarado Canyon limited access express way in the San Diego area traffic pattern. This route will enable traffic from El Centro, El Cajon, La Mesa, and similar points to flow freely to connections



gested El Cajon Avenue portion of U. S. 80 through the cities of La Mesa and San Diego. It is also a link in the Master Freeway Plan of Metropolitan San Diego.

16 Years of Effort

The dedication and ribbon cutting ceremony by the City of La Mesa was a fitting climax to the 16 years of effort by the county to make the Alvarado Canyon Road a reality, the first petition to the board of supervisors being dated August 12, 1934.

The five responsible governmental agencies through the following representatives expressed their views about the project at the dedication ceremony: E. F. Strickler, Senior Highway Engineer of the U. S. Bureau of Public Roads; Charles T. Leigh, member of the State Highway Commission; E. E. Wallace, District Engineer, Division of Highways; James A. Robbins, Chairman; David W. Bird and Frank A. Gibson, members of the County Board of Supervisors; Enoch E. Anderson, Mayor of the City of La Mesa and Fred A. Rhodes, City Manager of the City of San Diego.

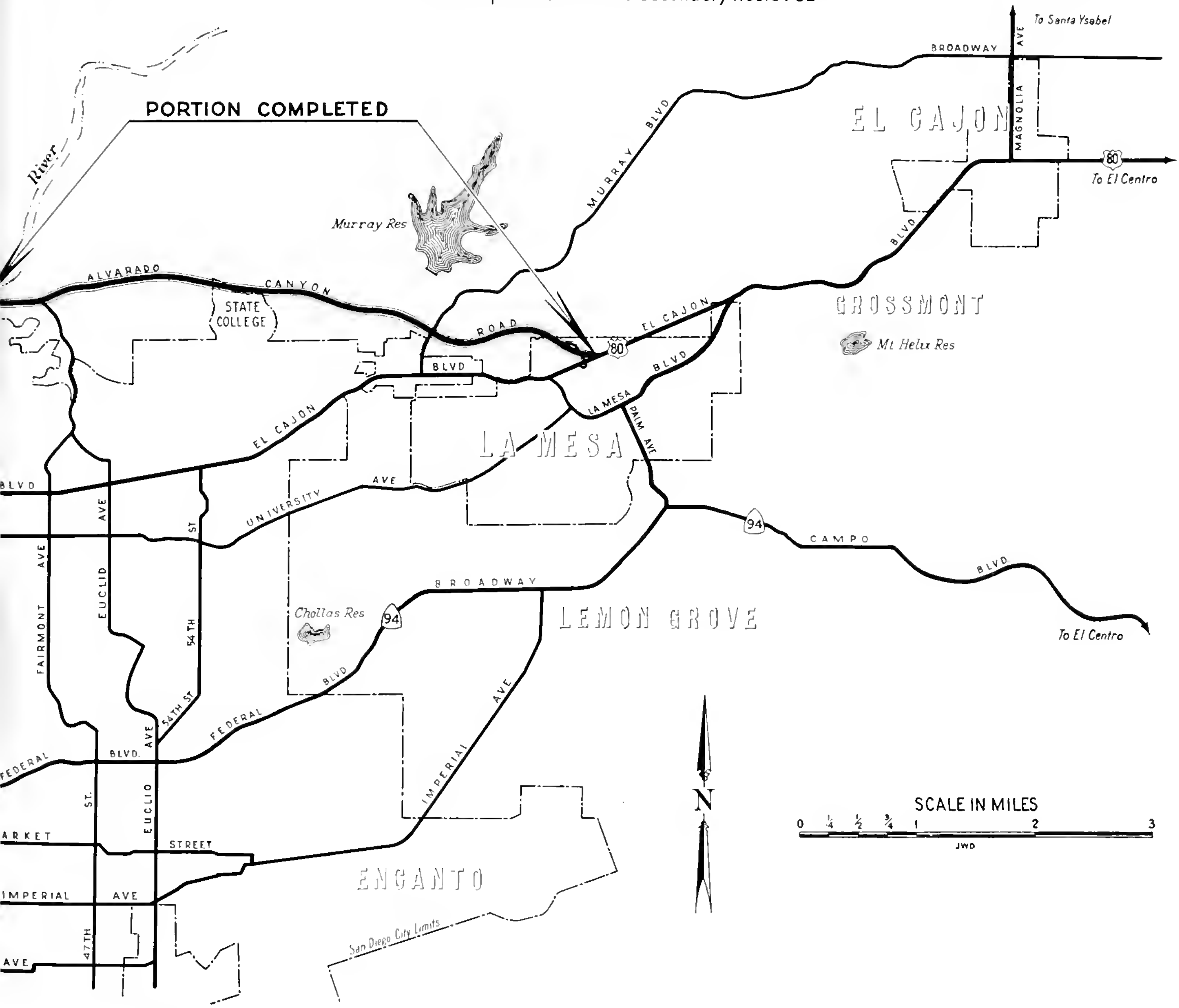
All of the above agencies and their many officials and employees, cooperated with the county in preparing the plans, obtaining rights of way and in clearing the legal requirements for the construction of this road. This was a clear demonstration that cooperation in the Federal Aid Secondary program can be successfully achieved by all levels of government working on a single project.

State Assistance

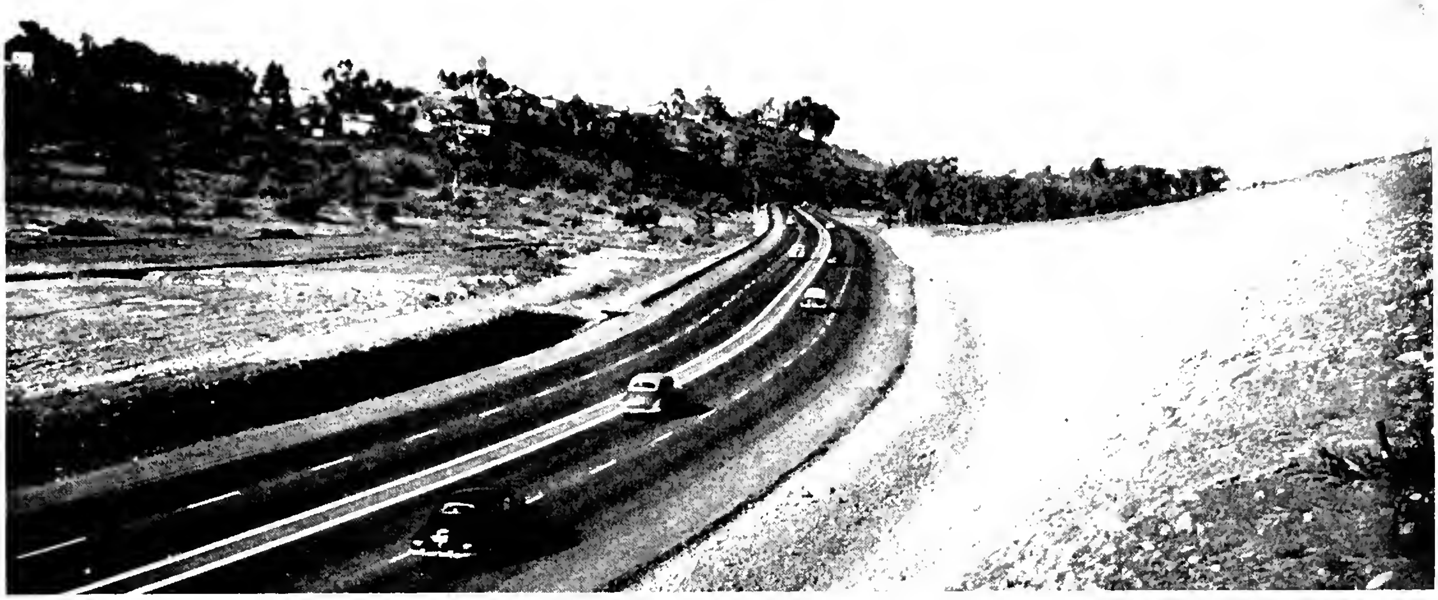
The Alvarado Canyon Road was the first limited access freeway project to

. . . Continued on page 46

with Fairmount Extension, the Cabrillo Freeway (U. S. 395), and the Pacific Highway (U. S. 101), thus avoiding time-consuming traffic congestion on existing routes. The portion in Alvarado Canyon recently completed and the portion proposed for immediate improvement comprise Federal-Aid Secondary Route 732



Aerial view of Alvarado Canyon Road looking easterly toward La Mesa. San Diego State College on right



UPPER—One of sections requiring heavy excavation. Looking westerly from La Mesa. LOWER—Looking northwesterly along project. Junction with El Cajon Avenue, U. S. 80, in foreground

Alvarado Canyon

Continued from page 43 . . .

be undertaken by the County of San Diego. Invaluable and unselfish engineering assistance by the District XI Office of the State Division of Highways in the design and preparation of plans and specifications, enabled the county, which was extremely short of engineering personnel, to finish the plans in June of 1947.

Delays due to the requirements of the Public Utilities Commission that a grade separation structure be constructed over the tracks of the San Diego & Arizona Eastern Railway Company at the easterly end of the project prevented the advertising for bids until August, 1948.

The contract for the construction of the road was awarded to the Daley Corporation of San Diego on September 27, 1948, with the work getting under way on October 26th.

The road is designed for a speed of 60 miles per hour with a minimum radius curvature of 1,500 feet and a maximum grade of 5.8 percent. Traffic was estimated at 6,000 vehicles per day. Actual traffic count since the highway has been opened is about 7,000 vehicles per day.

All items of work were constructed to the specifications of the State Division of Highways.

Project Cost $826,860

Due to the lack of funds it was decided to place a two-inch road-mixed surface on a one-inch cushion course over 7 or 13 inches of processed selected material. When traffic increases in a few years it will be necessary to pave the road with a high type rigid pavement and curbed median strip.

The roadbed section is 66 feet wide, composed of four traffic lanes divided by a four-foot median strip with eight-foot shoulders, plus three-foot berms or ditches.

The total cost of project was approximately $826,860, exclusive of engineering.

Right of way was provided by San Diego County and the City of La Mesa. Preliminary engineering was provided by San Diego County with the cooperation of the Division of Highways; construction engineering was under the direction of Frank D. Pearce, Resident Engineer for the highway construction and W. V. Cryderman, Resident Engineer for the bridge construction, both from the Division of Highways; the county furnished an assistant resident engineer and survey parties.

The construction costs and construction engineering costs were financed from federal aid secondary funds provided by the Federal Aid Highway Act of 1944, and state matching funds provided by the County Highway Aid Act of 1945 and the Construction and Employment Act of 1946, Chapter 20. The City of La Mesa also provided some funds from its one-quarter-cent gas tax allotment from the State.

HARRY R. SHEPPARD
21ST DISTRICT, CALIFORNIA

HOME ADDRESS:
YUCAIPA, CALIF.

VICE CHAIRMAN
ARMED SERVICES APPROPRIATIONS

Congress of the United States
House of Representatives
Washington, D. C.

January 25, 1950

Hon. Ed. Hyatt
State Engineer
Sacramento, California

Dear Ed:

As members of California's Delegation in the House of Representatives, familiar with your long and distinguished work for California's water resources, we have received with deep regret the news of your retirement. We will miss you. Every part of the State has witnessed some part of your service: the Central Valley Project, the State-wide water plan, the Colorado River projects, the flood control program, and many others. In all these water resources California is richer because of your quarter-century of effective service as State Engineer and in related responsibilities. The California Delegation extends to you its best wishes for your future happiness and success.

Cordially,

John Phillips
Cecil R. King
Cecil F. White
Chet Holifield
Norris Poulson
John F. Shelley
Franck R. Havenner
Geo. P. Miller
Jack Z. Anderson
Leroy Johnson
Carl Hinshaw
Harry R. Sheppard
Gordon L. McDonough
Clinton D. McKinnon
Ernest K. Bramblett
Clair Engle
Hubert B. Scudder
T. H. Werdel
Clyde Doyle
Richard Nixon

BLUEPRINT AND DIAZO REPRODUCTION MATERIALS

By G. G. McGINNESS, Assistant Stores Engineer

Blueprinting is probably the most widely used process for reproduction of drawings, plans and maps. The word "blueprint" is used broadly by many to include other reproduction processes and may mean prints of engineering drawings, a well-defined plan, a program or scheme, or even war strategy. Since Sir John Herschel developed the process in 1842, blueprints have provided the medium for conveying the engineer's or architect's vision of a completed machine or structure to the many craftsmen who do their part in the fabrication and erection.

Actually blueprinting is a distinct process whereby contact photo-reproductions are made by the use of a complex iron salt in contrast to the silver halides used in ordinary photography. The basis of the blueprint process is the changing of a soluble chemical to an insoluble chemical by exposure to light.

Blueprint Paper

Blueprint paper is a white opaque paper free from sulphites, coated with a solution of citrate of iron and ammonia, and ferricyanide of potassium, which, when fresh, is a yellowish-green color. On exposure to light, a chemical reaction takes place rendering the exposed portion of the print insoluble, and when fixed by washing in water, produces a strong blue color. Portions protected from the light by black lines of the tracing wash out, leaving the white paper. Thus the tracing is reproduced on a print with white lines on a blue background. The blue is often intensified by dipping the print in a solution of potassium bichromate.

With age or exposure to light or air, undeveloped blueprint paper turns to a grey-blue color and spoils altogether in a relatively short time.

Most blueprints are made on paper, but those that are to be subjected to very rough handling or are for permanent record may be made on sized cloth.

Blueprints after development are quite stable and if fading does occur, almost 100 percent recovery may be secured by placing the blueprint in the dark for several days.

Blueline prints on either paper or cloth are processed in the same manner as blueprints except that the material is exposed to light through a copy of the tracing with clear lines on a dark brown or opaque background.

Dioza Type Prints

While blueprints just described are better known, and the term "blueprint" is very commonly used, other prints, known as whiteprints, have been in use for the past 20 years and are being used today to a greater extent than many of us realize. These whiteprints are described as being of the diazo type. They have become popular because they are positive or right reading prints, having black or colored lines on white backgrounds, while the blueprints are negative reading prints, having white lines on blue backgrounds. A whiteprint is, therefore, usually easier to read and corrections may be noted thereon with pencil or ink, whereas on a blueprint any corrections or notations must be made with a white or light colored pencil or ink.

All that is drawn or printed on the original is reproduced on the diazo paper in black or color on a white background. As most printed matter such as letters, newspapers, etc., is printed with black ink on a white background, whiteprints combine well with common forms of printing.

Whiteprints Popular

Another reason for the popularity of whiteprints is that they are faster and easier to make. It is estimated by a survey among coated paper manufacturers and reproduction shops that 50 percent of the prints now produced in the United States are of the diazo type.

Diazo type prints fall into two chemical groups. One group is classified as semi-moist and includes such brand names as "BW" (Black and White), "Directo," and "Blacline." They are developed by simple machines which apply a thin film of developing solution to the face of the exposed print. These diazo type prints are known as *one component papers.* The light sensitive diazo dye is a part of the sensitizing solution applied to the paper and the "color giving" or azo coupling compound is contained in the developing salts. By keeping the diazo dye apart from the azo coupling compound the keeping quality or shelf-life of the sensitized paper is enhanced. When these two chemicals merge in the proper medium, they form a dye which produces black or colored dye lines.

Ammonia Developed Papers

The second diazo type group includes ammonia developed papers. The process is associated with such brand names as "Ozalid," "Vapo," "Helios," and "Dri-Print." ("Ozalid" is the word "Diazo" spelled backwards with "L" inserted for phonetic completeness.) These papers are known as *two component papers.*

Here, both chemicals, the diazo dye and the azo coupling component, are coated on the paper and remain practically uncoupled until the paper is placed in the developer medium; in this case, ammonia vapor fumes contained in a sealed chamber. Exposure of ammonia developed papers is accomplished in the same manner as semimoist papers, as mentioned heretofore.

All of these reproduction processes are based upon light passing through transparent papers or cloths and exposing the portions not covered by ink or pencil lines on the tracings. Where the light penetrates, it renders insensitive the diazo dye and where it does not, the diazo dye couples with the azo color compound.

New Development

Recently, a new development has been introduced to the semimoist diazo field. This product is known as "reflex film." It enables one to copy *opaque* subjects, such as magazine pages, and other materials which may be printed

. . . Continued on page 61

El Centro Blvd.

Sutter County Works on New Direct Route to Sacramento

By CARL F. LIND, County Engineer and Road Commissioner

For at least 10 years the officials of Sutter County have talked and planned of a new direct route between Yuba City, the adjacent Sutter County area and the City of Sacramento. This dream is finally coming to a realization with the construction of the newly located El Centro Boulevard, which is on federal aid secondary county Route 926 between Yuba City and Sacramento.

The project was divided into two contracts, one for the 617-foot bridge at Cross Canal and one for the roadway construction from Striplin Road, about 4 miles south of East Nicolaus, to the Sacramento County line, a distance of 7.9 miles.

Cross Canal Bridge

Bids were opened for the bridge on November 17, 1948. Lord & Bishop of Sacramento were low bidders with a bid of $122,140. This bridge is a reinforced concrete slab structure 617 feet in length and 30 feet over-all width with a 26-foot clear roadway width. There are 28 spans supported on precast reinforced concrete pile bents. The end bents were open end type and the bridge was constructed with timber railing; beam type metal plate guard railing was installed on the approaches.

Bids for the roadway portion of the new route were opened February 9, 1949, at which time P. J. Moore & Son and Harms Bros. of Sacramento were low with a bid of $234,033.05.

Due to the lack of funds to complete the entire project to standard construction, it was decided to build the roadway by stage construction. One hundred feet of right of way throughout the project was acquired. A turn pike section was designed using the entire width of right of way with the ditch section providing material for embankment to raise the road bed out of the heavy adobe subbase soil. This section also provided sufficient width for a tractor lane on either side of the pavement.

Cross Canal Bridge on El Centro Boulevard

Through Agricultural Lands

The route traverses agricultural land, the most of which is devoted to rice crops with consequent flooding of adjacent fields and saturation of the subbase. The final road bed was built to provide a traveled way 22 feet in width with four-foot shoulders. Twenty-eight thousand cubic yards of borrow to build bridge approaches were obtained from the channel of the drainage canal. The remaining material was obtained from the ditch sections.

The timing of the grading was very critical, since it was necessary to do the grading work between the period of the winter rains when the country was practically impassable and during spring when the irrigation canals were filled and the adjacent rice fields flooded. It was, therefore, necessary to immediately excavate the ditches of the turn pike section over practically the entire job in order to control drainage and permit grading work to proceed on the roadway itself.

Drainage System

Sand borrow to a depth of nine inches was obtained from local deposits to provide a blanket over the adobe of the graded road bed. A six-inch gravel base was placed over this sand borrow. The gravel was obtained from a county pit on the Bear River, an average haul distance of 15 miles.

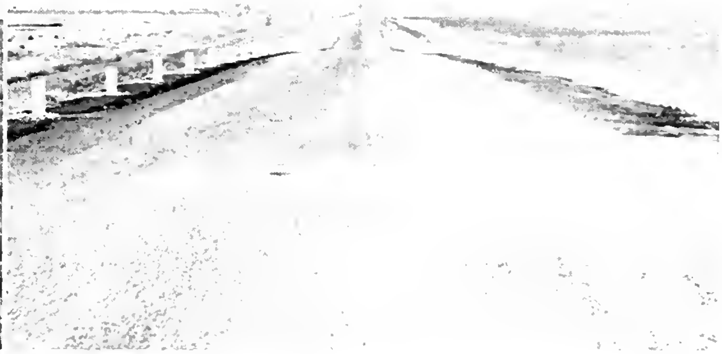
For the purpose of drainage, concrete pipe was chosen throughout the entire project. Concrete pipe varied in size from 12-inch for driveway side drains up to double 60-inch pipes.

. . . Continued on page 53

The photos on the opposite page, all looking north, show before-construction views of El Centro Boulevard in left-hand column and after-construction views of same sections in right-hand column





New Route

Continued from page 13 . . .

they are so arranged and their curvature so flat that it gives the appearance to the traveling public of one long tangent.

The rapid development on the adjacent and formerly agricultural land also required a change from barb wire fences to the more positive protection of chain link fence. Hence, a four-foot chain link fence will be installed throughout the suburban areas requiring 21,850 feet of fence on the expressway and 2,200 feet on the Charter Way extension, or a total of 24,050 lineal feet. This fencing is constructed with state-furnished metal fence posts set 10 feet apart, the posts being braced at 150-foot intervals with the braces and posts set in concrete. This makes a very economical installation and appears to be entirely satisfactory, the cost being approximately 60 cents per lineal foot.

Paving Completed

All of the concrete paving on this project was completed during the 1949 period. However, as winter developed, the work was slowed down and during January and February, 1950, was practically at a standstill. However, with the coming of spring, work is again in full swing and it is anticipated that the project will be completed and opened to traffic prior to June 1, 1950.

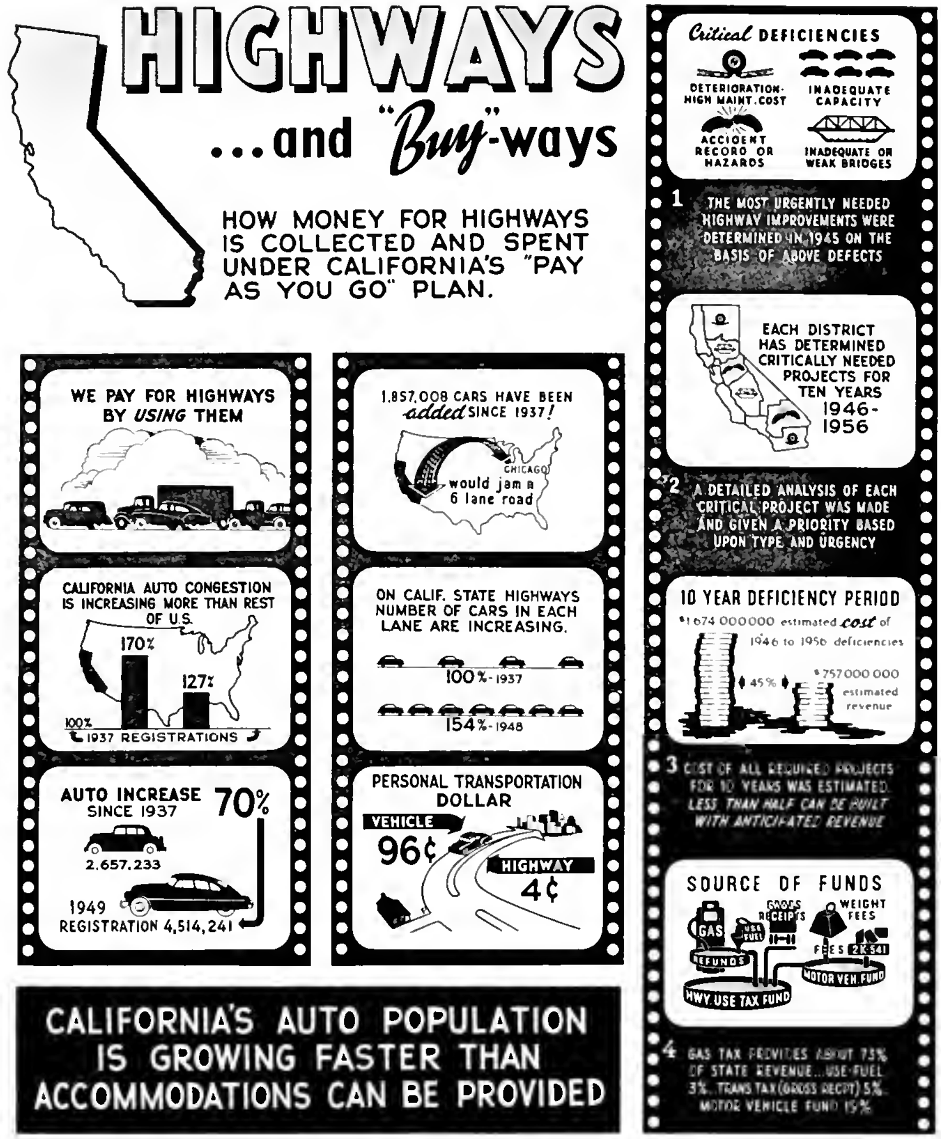
During March of 1950 a contract was awarded to R. Goold and Son for the illumination of the major intersections on the project. These illuminations, which consist of 64 individual lights, will be placed at the intersections of the expressway with Mariposa Road, Farmington Road, Main Street, Washington Street, Fremont Street, Waterloo Road, Cherokee Lane and at the north end of the project near Calaveras River and at the intersection of D Street with Route 50. It is expected this work will be completed by the time the project is opened to the general public.

Major Items of Work

The major items of the work which includes the two major contracts are as follows:

Roadway excavation	377,780 c.y.
Imported borrow	100,380 c.y.
Imported base	156,600 c.y.
Imported subgrade material	17,350 c.y.

. . . Continued on page 53



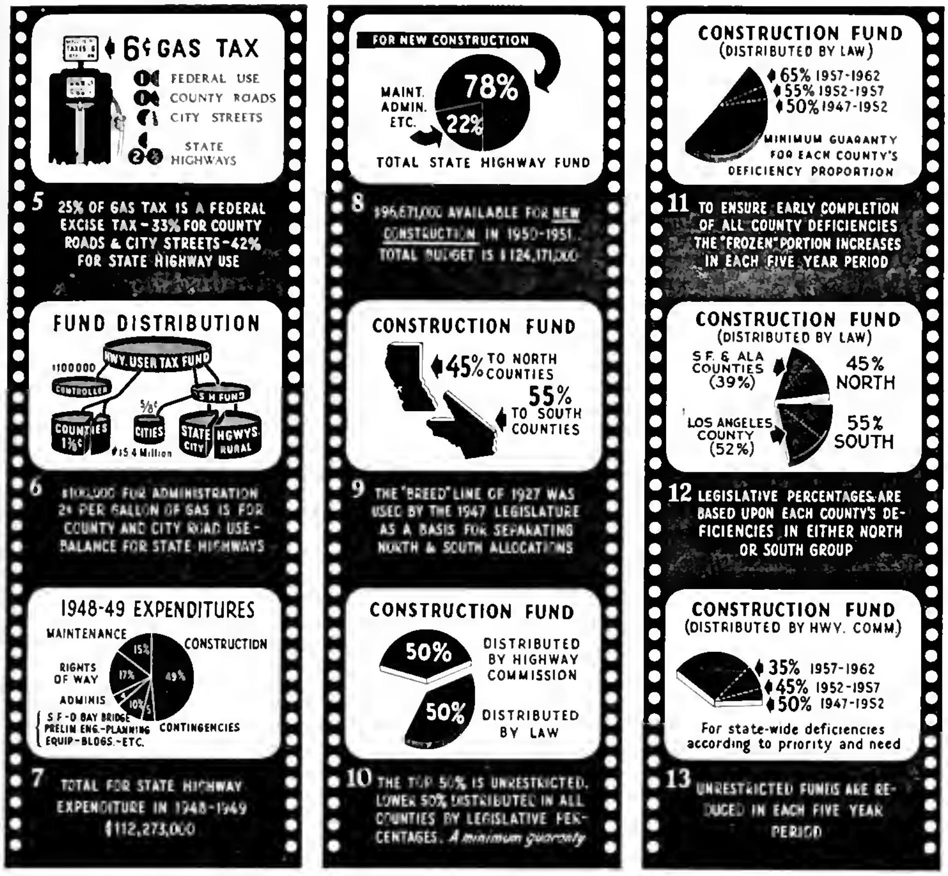
By J. W. VICKREY, Assistant State Highway Engineer

EACH CALIFORNIA motorist today must share the State's streets and highways with over 4½ million other motor vehicle drivers.

There are nearly 60 percent more passenger cars and other motor vehicles on California's highways today than there were a dozen years ago. Over 1,700,000 more cars, trucks, busses, trailers and motorcycles have since been added to the all-time high of 2,650,000 motor vehicles in 1937. California's auto population is continuing to grow at a faster rate than the rest of the United States.

Little do we realize that the increase in the number of motor cars is more rapid than the increase in driving space upon which to operate these motor cars. Today, we have an average of 54 percent more cars on each of the driving lanes than we had 11 years ago. More driving room is the motorists' cry.

Incidentally, it may be noted that for this privilege of highway movement, the average motorist spends but 4 cents for the roads and highways upon which the vehicle must be driven while 96 cents of his transportation dollar is spent on the motor vehicle, its maintenance and the cost of its operation.



Today's most critical highway deficiency is the lack of enough lanes for the rapidly increasing number of motorists in California. By January 1, 1950, the California Highway Commission had declared 1,440 miles of major routes as freeways, of which 675 miles are constructed on a multi-lane standard.

The problem of determining and meeting highway needs was carefully studied in 1945. Critical deficiencies were observed and tabulated to obtain a state-wide picture.

The estimated cost of all proposed projects was based upon expressed trends in construction prices together with a conservative projection as to future costs.

The Collier-Burns Act of 1947 provided an increase in highway revenue which, however, was estimated to cover but 45 percent of the 10-year deficiency program.

Under the Collier-Burns Act, gasoline taxes provide about 73 percent of the streets and highway fund. Although the Collier-Burns Act increased gasoline taxes by 1½ cents per gallon, California is still lower than 28 other states and over one-half cent per gallon less than the average of the Nation.

It should be noted by the motorist that of the 6-cent gas tax that he pays at the service pump, only 4½ cents of that tax is directly available for California's road use. A federal tax of 1½ cents is included. Federal funds amounting to about 20 percent of the funds collected return to California for its road use.

Proposed expenditures for 1950-51 total $124,171,000. Of this amount, approximately 78 percent, or $96,671,000, will be used for new major and minor construction projects including a small percentage for contingencies, for rights of way, preliminary and construction engineering, planning ond for the operation of the San Francisco-Oakland Bay Bridge.

Harrison R. Baker Gets Third Term

Governor Earl Warren, on February 11th, reappointed State Highway Commissioner Harrison R. Baker for a third term. The new appointment, subject to confirmation by the State Senate, will expire January 15, 1954.

Originally named to the post on September 14, 1943, Mr. Baker won a three-year term when the newly appointed highway commissioners drew lots for staggered tenures of office. He was reappointed in January 1946 for a four-year term.

NEW NAME ON LIST

LIVERMORE ELEMENTARY SCHOOL DISTRICT

LIVERMORE, CALIFORNIA

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: I have before me a loaned copy of the November-December, 1949, issue of *California Highways and Public Works* and am amazed at the abundance of educational material contained therein.

We shall consider it a favor if you will put our school system on your mailing list.

Respectfully yours,

JOE MICHELL
Superintendent of Schools
President Livermore C. of C.

HIGH PRAISE

THE STATE OF WISCONSIN
Highway Commission

MADISON 2, WISCONSIN

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR SIR: I have found a great deal of interest and value in *California Highways and Public Works* and hope that it may continue to come to me. It is the most valuable magazine of its type that I have had the privilege of seeing.

Very truly yours,

STATE HIGHWAY COMMISSION OF WISCONSIN
WAYNE N. VOLK
Traffic Engineer

Traffic Striping

Continued from page 4 . . .

The men placing the spots were required to walk for long distances along the center of the highway between lanes of moving traffic and while watching the rope closely, were unable to clearly observe approaching vehicles. This phase of the work had become so critical that left-handed persons were banned from striping crews because in spotting with the left hand they walked within the traffic lane where vehicles approached them from the rear. Because of their inability to observe these vehicles, several severe injuries have been incurred by left-handed crew men.

Complete spotting equipment upon completion of a run

New Striping Ideas

Much consideration and experiment have gone into efforts to eliminate some of the hazards and to reduce the cost of spotting for new stripes. The traffic striping crew of Highway District VIII under the direction of Foreman W. V. Barrett has developed a few ideas which we feel may be of interest in this respect. Our aim has been to eliminate as far as possible the practice of men working on foot along the center of the highway. By using equipment for this work the crews are assured of greater safety and the work is expedited.

On the front bumper of a light express truck we have mounted a standard paint spray gun with the nozzle adjusted to about three inches above the pavement surface. The spray gun is actuated by means of a solenoid magnet coupled to the control trigger and operated by the operator of the truck by means of a switch button on the steering post. The complete actuating device was taken from a standard automobile starter of the dash button type; however, the starter button was moved to the steering post and fitted with a short lever to permit easy and rapid manipulation.

How It Is Done

To lay out a new stripe a surveyor's transit is set up on an established point on the proposed line about one-half mile ahead. It is sighted back toward the established starting point. Another light express truck equipped with signal lights is parked at the rear of the transit man. The spotting truck is driven in a slightly zigzag course, back and forth across the line of the proposed stripe, not varying more than a foot to either side. The operator is guided by the transit man who indicates by light signals when the nozzle of the spray gun passes across his line of sight. The operator of the spot truck sprays a spot of paint on the pavement at that point and by repeating this operation a line of spots is produced at about 50-foot intervals from the starting point to the transit. The transit man then moves his equipment ahead while the spotting truck remains parked on the last spot to serve as a back sight for the next transit setting. This procedure is repeated until the required distance is covered. By using a hair line sight on the striping machine this line of spots can readily be followed to produce a very satisfactory finished traffic stripe.

Time Is Saved

A great deal of time is saved in spotting by this method—it being possible to spot at the rate of about sixty miles per day as compared to about eight miles per day by the "pig tracking" method. In addition the safety factor is greatly increased because all crew men involved are either within or adjacent to vehicles equipped with flashing red lights which present a very evident warning to approaching motorists. We have not yet had sufficient use of these devices to give any accurate cost data, but it is evident that the saving will be considerable.

This process is still under development and refinements are expected to be made from time to time. Two new ideas we are considering are: First, an easily set, readily adjustable transit mount to expedite the setting of the instrument, and second, the actuating of the spotting spray gun directly by the transit man, by radio control. The latter would eliminate errors due to perception and reflex time of the operator of the spotting truck and also relieve him of the strain of constantly watching the distant light signals. We feel that when these ideas are worked out we will have made appreciable progress in traffic striping procedure.

FOR YOUR PROTECTION

Traffic laws are not unfair restrictions intended to limit the freedom of the motorist. They are intended for everybody's protection, walking or driving. Be safe by obeying them.

Main Street Overhead in foreground. Separation of U. S. 90 and U. S. 50 routes in background

New Route Around Stockton

Continued from page 50 . . .

Structural excavation	24,000	c. y.
Ditch and channel	5,300	c. y.
Overhaul	17,500,000	sta. yds.
Build shoofly trestle	$17,350	
Remove and reconstruct railroad	$22,725	
Class "A" P. C. C. structure	7,938	c. y.
Structural steel	1,499,500	lbs.
Reinforcing steel	1,227,000	lbs.
Timber piling	6,475	l. f.
Concrete piling	8,825	l. f.
Steel railing	2,926	l. f.
Property fence	10.50	miles
CMP "8" to "48"	12,292'	l. f.
Welded steel pipe	3,850	l. f.
Mix and Compact CTS	179,400	sq. yd.
Portland cement	6,350	bbls.
Untreated rock base	32,300	tons
Mineral aggregate	15,950	tons
Paving asphalt	764	tons

Cost $3,100,000

The cost of the work including grading, structures, paving and lighting is approximately $2,650,000. The cost of right of way and the reconstruction of utilities amounts to approximately $450,000 for a grand total of approximately $3,100,000 for 5.2 miles of four-lane expressway and two miles of two-lane highway.

A. N. Lund was Resident Engineer at the start of the original contract and after his promotion to Assistant District Construction Engineer, Frank Fleharty took over his duties. The structures were under the general direction of Wayne Deady of the Bridge Department. Work was under the general supervision of M. C. Fosgate, District Construction Engineer.

El Centro Blvd.

Continued from page 48 . . .

Drainage structures included a double 6-foot by 6-foot reinforced concrete box culvert.

In order to allow for future additional base and to keep costs within available funds, it was decided to surface the central 22-foot portion of the 6-inch gravel base with a Class "B" double seal coat.

It is interesting to point out that, although the project is a county project, financing was accomplished with funds provided by the Federal Aid Highway Act of 1944, the County Highway Aid Act of 1945 and Chapter 20 funds. No county funds were necessary thus making the project a tribute to the judicious use of federal aid secondary and state funds.

To Be Extended

Preliminary engineering work was under the supervision of the author. Construction engineering on the roadway portion was handled entirely by engineers of the county road department. Construction engineering of the bridge was undertaken by the State Bridge Department. With the cooperation of District III's Construction Department, Materials Section, and Federal Aid Secondary Department, it is felt that a fine job was achieved.

Sacramento County has extended the road with a similar design section for the next one and one-half miles south of the county line, and sometime in the near future it is hoped that the improvement of this new route will be extended through to Sacramento thus providing a quick and easy route between Sacramento and Yuba City and Marysville.

The newly constructed road lies entirely in Sutter County Supervisorial District Five, of which Eber F. Beilby is the supervisor. Elwyn E. Watkins was resident engineer on the road and E. L. King was resident engineer on the bridge.

HILLS AND CURVES

Never attempt to overtake and pass another car near the crest of a hill or on a curve, where your range of vision is restricted. Keep to your own lane until you have ample sight distance for safe passing.

In Memoriam

WILLIAM TAFT HAIGHT

William Taft Haight, 57, Senior Bridge Engineer with the California Division of Highways, died February 26, 1950, in Glendale, California, after an illness of several months.

Mr. Haight was a graduate of the College of the City of New York and he spent the next five years with the Public Service Commission on the New York Subway and Elevated Railroad System, the New York State Highway Commission and the Baltimore and Ohio Railroad.

He served in the U. S. Army as a commissioned officer during World War I. For four years following the war he was with the New Jersey State Highway Commission, followed by nine years in private engineering and contracting practice in Los Angeles, California, and one year as Construction Engineer, U. S. Forest Service.

From 1933 to 1936 he was on the construction of the San Francisco-Oakland Bay Bridge, followed by four years on bridge construction in Southern California with the Division of Highways.

In 1940 he was called from the reserve into active service with the U. S. Army, and within a period of two years rose from the rank of Captain to that of Colonel and Chief Engineer of the 4th Air Force Area. As such he was in responsible charge of all engineering work connected with the airports of the 4th Air Force area. He was discharged for disability in 1946 and returned to the Bridge Department of the California Division of Highways where he was in direct charge of construction of many millions of dollars worth of bridges in Southern California up to the time of his death.

Col. Haight was awarded the Legion of Merit for "Exceptionally meritorious conduct in the performance of outstanding services from January 1941 to January 1946."

Cooperation

Continued from page 11 . . .

locate themselves and, of primary importance, good highway facilities which will be of the finest when the East Shore Freeway is opened to traffic so as to place San Leandro within 15 minutes of the center of Oakland and within 35 minutes of San Francisco. Here again the developers have extended full cooperation in setting aside the needed portions of their lands until such time as these portions are required for the freeway construction.

All who will enjoy this new East Shore Freeway are deeply indebted to the coordinated efforts of State, county, and city organizations, as well as to the cooperation of the many subdividers along the route, including C. P. Pond, C. W. Leekins, J. E. Kenney, Valley & Lincoln and David D. Bohannon.

AID TO OTHER COUNTRIES

INTERNATIONAL ROAD FEDERATION

Washington 5, D. C.

Mr. Kenneth C. Adams, *Editor*
California Highways and Public Works
Sacramento, California

Dear Mr. Adams: We have been receiving your magazine "*California Highways and Public Works*" for some time now and have found it very valuable in our work of promoting better highways in other countries of the world.

Cordially yours,

Francis E. Twiss
Director of Planning and Economics

FROM A TAXPAYER

Pasadena, California

Mr. K. C. Adams, *Editor*

Dear Mr. Adams: I wish to tell you how much, as a taxpayer and property owner, I appreciate your journal both editorially and the high grade and the excellence of its mechanical get-up, and I want to thank you for the share you have in it.

Yours very truly,

Cornelius Jansen

In Memoriam

JOHN A. MOFFITT

It was with deep sorrow that the many friends of John A. Moffitt at the San Francisco-Oakland Bay Bridge and other units of the Division of Highways learned of his sudden death on January 2, 1950.

Mr. Moffitt was born on October 23, 1893, at San Lucas, California. Not long after his graduation from high school in 1912 he entered the United States Postal Service where he remained until May 1917 when he enlisted in the United States Army. He served throughout World War I, taking part in several major battles, and was discharged on June 1, 1919.

He immediately reentered the Postal Service and continued in this work until April 1, 1931, when he was employed by District V of the Division of Highways as a laborer. He later became a highway leadingman and, while working in this capacity, was transferred to the San Francisco-Oakland Bay Bridge on July 1, 1939. He was advanced in 1944 to the position of highway maintenance foreman on the Bay Bridge. In this position, which he still held at the time of his death, he had charge of all roadway maintenance work on the bridge and the continuous 24-hour operation of the emergency fleet of tow, fire, and patrol service trucks.

Mr. Moffitt is survived by his widow, Ethel B. Moffitt, five sons, John A., Jr., William F., David R., James Vargas, and Frederick C., and a daughter, Mrs. Don Kaus, to whom sincere sympathy is extended.

With a profound sense of loss, his associates on the Bay Bridge join his many other friends in saying farewell to "Jack" Moffitt, who was for all of us a symbol of genuine service and an ideal to be imitated in his unselfish devotion to his responsibility.

Freeways

Progress Toward the Ultimate In Highway Transportation

By FRED J. GRUMM, Deputy State Highway Engineer

The following poper was presented by Mr. Grumm to the Highway Division, American Society of Civil Engineers, at the annual meeting of the society in New York.

THE WAR'S END served to emphasize and highlight the accumulating inadequacies in the highway systems of the country. The release from fuel restrictions had the sudden effect of a physical blow in the outpouring of traffic on the highways. All the shortcomings, that had increased so inevitably in the nineteen thirties, were suddenly quite alarmingly apparent. They exceeded the most pessimistic predictions.

The statements in this paper apply particularly to California. Our experience, however, is probably typical and is paralleled by other states and communities. The same phenomena which are presented in our State can be found in a larger picture in the country as a whole or may be reproduced in a smaller community on a reduced scale. Our experience and progress in California should, therefore, be useful.

Whereas motor vehicle registration and highway use increased to over 500 percent from 1920 at 100, expenditures on the state highway system barely reached the 250 percent mark and never exceeded the amount available in 1930. This condition was exaggerated and aggravated by the war.

Highway Deficiencies

For the four years of the war, when maintenance operations were the only permissible activity on the established highways, we devoted the time of our reduced engineering forces to a detailed study of the deficiencies on the state highway system and to the completion of plans for correcting these deficiencies. By the end of the war, we found that these deficiencies had in many instances become critical and we so termed them in our report to the Legislature at its 1945 Session. Of these

Fred J. Grumm

deficiencies the large majority—about 75 percent—were of the type: "inadequate capacity."

Although traffic volume had been steadily increasing, two-lane roads as a whole were still functioning fairly well in the early part of the 'thirties except perhaps for some of the major and more important highways. These were cared for by simply increasing the number of lanes. The troubles of traffic congestion were not too widespread, but by 1935 were attracting the attention of the engineers. The dismal effect of "ribbon city" development became more pronounced and ironically on the very sections of highway we had improved to greater capacity. Conflict of vehicle movements, congestion, increased accidents always accompanied this development of abutting property; and as an attendant corollary there was inevitably the disappointing loss of capacity.

Only Temporary Relief

We were providing only temporary relief when we constructed additional lanes. We were wasting our money and efforts. The motor vehicle user, who contributed the funds for improving and maintaining the highways was getting little return for his money. The abutting property owner, who contributed nothing from property taxes toward the highway improvement, profited by the increased values created and helped destroy the efficiency of the road by his improvements.

The need for highways with maximum capacity and minimum hazard probably came on us gradually, but our awareness of the need came more suddenly. Diligent searchings and explorations for an adequate solution led to tentative consideration of the "freeway principle": The principle of control of access to the roadway. It became a law in California in 1939. Here a freeway is "a highway in respect to which owners of abutting land have no right of easement or access to or from their lands or in respect to which such owners have only a limited or restricted right of easement or access."

Freeway Definition

The American Association of State Highway Officials has adopted the following definition of a freeway: "An expressway with full control of access," and an expressway is: "A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections." Control of access in its adopted definitions is: "The condition where the right of owners or occupants of abutting land or other persons to access, light, air, or view in connection with a highway is fully or partially controlled by public authority."

To the ultimate solution, the important features of the "expressway," such as divided roadway, separated cross-traffic, no left turns, direct interchange facility, ample right of way, no pedestrians, simple and adequate signs, are a definite requirement, but the important fundamental quality that creates the high, lasting character is the "freeway principle."

After the passage of the freeway law in 1939, the discreet application of the principle to our highway improvement produced only a few examples of freeways before our efforts were halted by the war. Opportunity for observation under normal operation was limited as to time and the benefits produced, therefore, were not announced until proof by further experience could be provided. We now have amplified that experience; we have more and substantial proof of the qualities and characteristics of the freeway.

Freeway Benefits

The freeway eliminates the conflicting traffic movements that are induced by development of abutting property; it reduces congestion, accidents, and hazard; it produces greater freedom of vehicle movement and relieves the nervous strain of driving; it produces a highway facility with maximum traffic capacity and this inherent benefit is retained so long as the "freeway principle" is maintained.

Extended studies by the Committee on Highway Capacity of the Highway Research Board have developed evidence of the high capacity of a freeway. A four-lane freeway is equal in capacity to four city streets, 40 feet wide, with parking prohibited, or eight such streets with parking allowed and with the usual amount of left turning and pedestrian interference. Continuous uninterrupted traffic flow, as is possible on a freeway, is the basic reason for high capacity. The "freeway principle" is flexible and adaptable. As part of our present improvement we need but acquire adequate right of way, position our pavements to provide for expansion and thus provide for future needs, at the same time preserving the integrity and beneficial quality of our freeway.

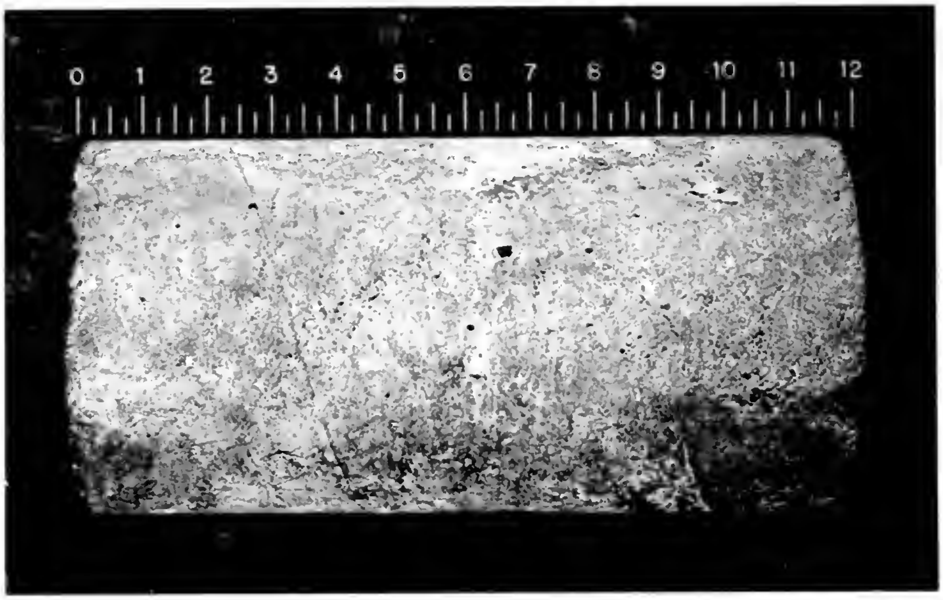
Reduction of Accidents

The freeway is a much safer facility than the ordinary highway. The principal causes of accidents—side friction, conflicting vehicle movement—have been eliminated by the control of access. Comparing accident ratios of Wilshire Boulevard in Los Angeles, a major traffic arterial, with the Arroyo Seco Freeway, we find: Wilshire Boulevard, a 70-80 foot wide street, six traffic lanes, no parking, controlled intersections, carrying approximately 40,000 vehicles daily, has an accident ratio of 2.53 per million vehicle miles; the Arroyo Seco Freeway is a six-lane divided freeway with no parking, no grade intersections, controlled access, carrying approximately 40,000 to 50,000 vehicles daily, has an accident ratio of 0.48 per million vehicle miles—one-fifth of that on Wilshire Boulevard.

Safer Highway Facility

The design features of the freeway all contribute to make it the safer, more comfortable highway facility. The divided roadways reduce the "ap-

Eighteen-Year-Old Concrete Cylinder Unearthed



This photograph shows 18-year-old concrete test cylinder which was unearthed

In connection with the widening of the Carnadero Creek structure on U. S. 101, near Gilroy, excavation in the creek channel unearthed a concrete test cylinder which had been cast 18 years ago during the construction of the original bridge. After it was originally cast the cylinder was apparently buried in the creek bed to complete its curing and then was subsequently either lost or forgotten. The cylinder was in good condition, although the cardboard casting mold had long since disintegrated. In an effort to discover what, if any, effect the aging had worked on the specimen, it was sent to the Division of Highways Laboratory for examination and testing.

During the original construction in 1931, some 14 test specimens were submitted in connection with the work and the average of the breaks for this six-sack concrete was 3,680 p.s.i. Some pavement concrete was also poured and four specimens were tested of the six-sack pavement concrete and they averaged 3,526 p.s.i. The single specimen discovered in 1949 was photographed and subjected to various tests in the laboratory. It was in good condition and developed a very high unit strength.

After 48 hours, soaking in water at 70 degrees to conform to standard conditions, the compressive strength was found to be 6,495 p.s.i. The dynamic modulus of elasticity was found to be 6,702,000 p.s.i. The secant modulus of elasticity at 1,000 p.s.i. was found to be 5,517,000 p.s.i. The weight per cubic foot was 150.4 pounds.

The fracture was of the double cone type and mortar strength was such that considerable fracturing of the coarse aggregates was observed.

Although the test results were possibly of small value in connection with the evaluation of the concrete in the original job, the finding of this cylinder provided an opportunity to make some interesting studies as to the effect of age upon concrete.

proaching" type of accident; the wider lanes and shoulders supplement the elimination of side friction to reduce the "overtaking" type; and separation of grades with the elimination of left turns reduces the "crossing" or "intersecting" type of accident. In the freeway we have developed a highway that possesses the good and desirable qualities of maximum capacity, safety and comfort, and one that is free of the undesirable faults of the ordinary road or street.

Indirectly, the freeway produces other benefits that make it a desirable addition to any community or area. The freeway fosters the economic growth of a community. It enhances the value of adjoining and nearby properties to more than offset the loss of tax revenue from the lands included within the highway right of way and thus removed from the tax rolls. The case study of the Bronx River Parkway made by John Nolen and Henry V. Hubbard and published in their book "Parkways and Land Values" is probably known to you. They present proof that the parkway participated in creating gains in land values in the area affected by the parkway and that these gains were greater in the narrow strip adjacent to it. They indicate that gains of as much as 700 percent may be ascribed to the parkway.

Freeway Boosts Land Values

We recently completed a study of sales of property abutting the freeway in San Joaquin Valley along State Highway Route 4–U. S. 99. All recorded sales of land, abutting the freeway and the frontage or service road, made after the completion of the freeway, were examined. We found that in no case was the payment for land less than the appraised value for which the right of way was acquired. Most of the sales ran from two to six times the appraised value at the time right of way was acquired. Our appraisals were based on fair market value and right of way was acquired at the appraised value. Similar increased values have been observed on other of our freeways.

The reporting of critical deficiencies on the state highway system to the Legislature in 1945 led to the appointment of a legislative Committee on Highways, Streets and Bridges. Its studies extended over a two-year period and embraced county roads and city streets as well as the state highway system. The continuing increase of traffic had also exacted its toll from county roads and city streets. The road and street taxes collected by the local governments were no longer sufficient to meet the demand of increased traffic.

State's Burden Increased

Over the later years a gradual shifting of the burden from local government to the State has taken place. This shift was partly in the transfer of roads and streets to the state highway system and principally in the State's assumption of the greater part, if not all, of the cost of county road and city street administration. These costs are a subsidy to the counties and cities from the State to the extent that very few if any property taxes are levied by the counties and cities for road and street purposes.

The legislative committee's studies resulted in the introduction of bills at the 1947 Legislative Session providing for additional funds derived from motor vehicle and motor vehicle fuel taxes for state highways, county roads and city streets. Over the organized and bitter opposition of the oil companies, the Collier-Burns Highway Law was finally enacted and approved. Increased funds were provided for all three road systems.

Typical Budget

The increased amount produced for state highways exceeds previous amounts by about four times; for construction, about six times. It can be illustrated by using a typical year allotment. The amount available for construction alone in the 1950-1951 Fiscal Year is approximately $90,000,000. Construction in the law is defined to include engineering, rights of way, and construction. The respective percentages of these three are 7, 20, and 70. At the present rate of income, which includes federal aid, about 15 to 20 years will be required to correct the reported state highway deficiencies. These were estimated in 1947 to cost $1,600,000,000, plus.

We are now operating in the third year under the Collier-Burns Highway Act. A budget for the fourth year has been adopted and submitted to the Governor. The deficiencies receiving first attention are, of course, on the major arterials and in the larger metropolitan areas. We are increasing the capacity of these arteries. They are being improved as freeways.

Right of Way for Future

We are securing adequate widths of right of way—basic minimum width 170 feet—to accommodate a six-lane divided highway with all the necessary appurtenances: Acceleration and deceleration lanes, channelized intersection, grade separation and interchange structures, etc.

On some of our rural freeways we are resorting to stage construction. We are omitting temporarily, until traffic needs are sufficient, the ultimate refinements such as separation and interchange structures; but the design is developed and the right of way secured now so that these additional features, which are refinements now but will become necessities, can be readily fitted into place.

We make frequent use of a design providing frontage or service roads where we convert an existing highway into a freeway and where abutting property has been developed.

Status of Freeways

The status of freeways in California as of the end of 1949 was as follows:

	Miles
Total declared freeways at end of war, 9/1/45	588.8
Total declared freeways, 12/31/49	1,440.3
Freeways under construction, 12/31/49	98.2
Freeways completed to 6/30/45	328.7
Freeways completed 7/1/45 to 12/31/49	346.5
Total completed freeways, 12/31/49	675.2

Considerable progress is apparent on such main routes and interstate highways as U.S. 40, U.S. 99, U.S. 101, and U.S. 60, 70, 99 east of Los Angeles. The urban freeways in the Los Angeles and San Francisco Bay Metropolitan Areas are being completed for usable and serviceable distances. Some sections of these latter are of eight-lane divided type.

The "freeway principle" is the most valuable feature of present highway improvement. It will be the principle component of the ultimate highway facility.

The freeway must be recorded as one of the most important developments in highway transportation.

We are making progress. We are providing in our freeway construction a facility that presents the most complete service to traffic yet achieved; a facility that will endure and continue its beneficial service.

Are we not entitled to say that we are making progress toward the ultimate in highway transportation?

Vegetation Control

Heavy Duty Brush Cutter Is Successful on Highways

By R. A. MILLER, District Maintenance Engineer

Because of moderate temperatures and heavy precipitation in various sections of District I, the control of roadside vegetation is a constant problem. It has been observed in a certain section of Del Norte County where an existing highway was abandoned in favor of a new location that within a period of a few years the old highway was impassable due to the vegetation taking over.

The type of vegetation giving the greatest trouble is the alder tree, which thrives in the coastal temperatures and moisture. It is quite common for this tree to increase over an inch a year in diameter and consequently must be controlled continuously.

Brushing Necessary

Due to the shortage of manpower during the war years, the control of roadside growth was somewhat neglected in favor of keeping the traveled way in traversable condition.

It became apparent in the early part of 1948 that considerable brushing was necessary in order to restore the roadway to its former width and sight distance.

In the early summer of 1948, District I put into operation a heavy-duty brush cutter. This heavy-duty power mower is mounted on a special truck assembly. The machine has an International motor mounted on a revolving and extending carriage on the forward end of the vehicle. A heavy-duty sickle bar is mounted on the end of an extendible boom attached to the carriage.

Sickle Bar Control

The sickle bar is controlled by six hydraulic levers and the truck is driven by a separate engine through a conventional gearshift.

The machine will cut a six-foot swath through brush up to approximately three inches in diameter from one-half to one mile per hour, depending upon the diameter and amount of vegetation to be cut.

Brush cutter being demonstrated in Washington, D. C.

Here the cutter is making a first pass at the brush

These high slopes were cleared of bulging growth with mower

The flexibility of the machine is such that the operator is able to cut on any cut or fill slope as well as overhead. Extension of the carriage and boom will permit cutting brush as far as 17 feet from the machine.

Big Money Saving

In many sections on the Redwood Highway, as many as three passes were required because of the heavy brush encountered. The cost of cutting per roadside mile in these areas has been about \$82, with a cost of from \$25 to \$35 per roadside mile for brush removal. Compare these prices with the \$400 per roadside mile required when cutting is done by hand.

The subsequent control of vegetation with the brush cutter in the fall of 1949 at those locations previously cut out with the brush cutter in the fall of 1948 shows a decided decrease, being approximately \$10 per mile.

Several advantages accrue in the proper control of vegetation other than added width and increased sight distance. It has been noted in several locations that upon completion of clearing operations, the sun and increased circulation of air tends to keep the pavement drier and, consequently, less hazardous because of slippery pavement.

The foreground shows result of mowing brush on slope. Brush in background is typical before-mowing scene

Soil Erosion

Continued from page 41 . . .

investment which has been made in stabilization.

Use of Wet Material

Wet material which is end-dumped from a truck will frequently stand at an angle steeper than $1\frac{1}{2}:1$. This steeper slope can be considered an unstable one, since the $1\frac{1}{2}:1$ angle is that formed naturally by loose soil. When saturated by further rainfall, the dumped material usually slumps, effectively forming channels of concentration which intensify the control problem. When it is necessary to dump wet material over a slope, every effort should be made, first, to flatten and smooth the slope of the dumped material to $1\frac{1}{2}:1$ or flatter, and, second to stabilize the surface with straw, seed, and cuttings as insurance against future trouble.

It is usually possible to find a disposal area in which waste material can be safely dumped within a reasonable hauling distance on most mountain roads. The upper sides of small fills can sometimes be filled in, making a parking or stopping area for the motorist. Other low spots or gentle slopes can be covered with the waste; and if the slope is gentle enough, no further treatment need be given, except, possibly, seeding for the sake of appearance.

Since any form of slope stabilization treatment represents an investment, often a sizeable one, sound economic practice justifies the expenditure of a proportionate amount to protect the investment. The follow-up treatment described here may be carried out so cheaply and so effectively, *if done at the right time*, that its justification should never be questioned.

. . . to be continued

ACKNOWLEDGMENTS

Grateful acknowledgment is hereby made to the many persons who, by their suggestions and encouragement, have contributed to the preparation of this booklet.

Special acknowledgment is due Mr. Chas. C. Morris, Division Engineer of the Public Roads Administration, for suggesting that a publication describing our erosion control methods would be of interest to others faced with similar problems; and later for his review and suggested improvements in the manuscript. Also to Mr. Wilbur H. Simonson, Chief, Roadside

. . . Continued on page 60

In Memoriam

CARL S. T. MARCKHOFF

Veteran of 24 years service with the Division of Highways, Carl S. T. Marckhoff of Sacramento, State Highway Maintenance Superintendent, died on January 17th after a short illness. He had retired on November 18, 1949.

Born in Elgin, Illinois, on November 15, 1889, Mr. Marckhoff had been a resident of California for 30 years. He entered state service in 1921 as Assistant Resident Engineer in District III. He transferred to the Los Angeles office of the Division of Highways as Junior Civil Engineer in June 1924. He left his position for private employment at the end of 1924 but returned to the Division in the summer of 1929 as Resident Engineer in District III. From March 21, 1930, to November 1940, he was Maintenance Superintendent in Districts I, II, IV, V, and X, when he was transferred to the traveling bridge crew. He was brought to the Central Office in Sacramento in June 1944, remaining until his retirement.

Mr. Marckhoff was a member of the Columbus Chapter of the Order of the Eastern Star, the Blue Lodge of the Masons in Elgin, the American Legion and the 23d Engineer Corps Association. He served in France during World War I.

He is survived by his wife, Edith K. Marckhoff; son, William Carl Marckhoff of Pasadena; brothers, Alfred F. Marckhoff of Batavia, Ill., and Lorenz Marckhoff of Omaha, and sisters, Mrs. William Gerrish of San Francisco and Mrs. Ray Hoehn of Hayward. He was the brother of the late Mrs. Dorothea Niederholzer.

ACKNOWLEDGMENTS

Continued from page 59 . .

Section, Public Roads Administration; Mr. C. J. Krabel, Division of Forest Influences, U. S. Forest Service; Mr. J. S. Horton, San Dimas Experimental Forest, U. S. Forest Service; Professor Joseph Kittredge, Professor of Forestry, Forest Influences, University of California; and Mr. C. H. Gleason, Forester, U. S. Forest Service, for their valuable suggestions and constructive criticism; and to Mr. L. S. Manning, Associate Landscape Architect, California Division of Highways, for his compilation of this manuscript.

H. DANA BOWERS

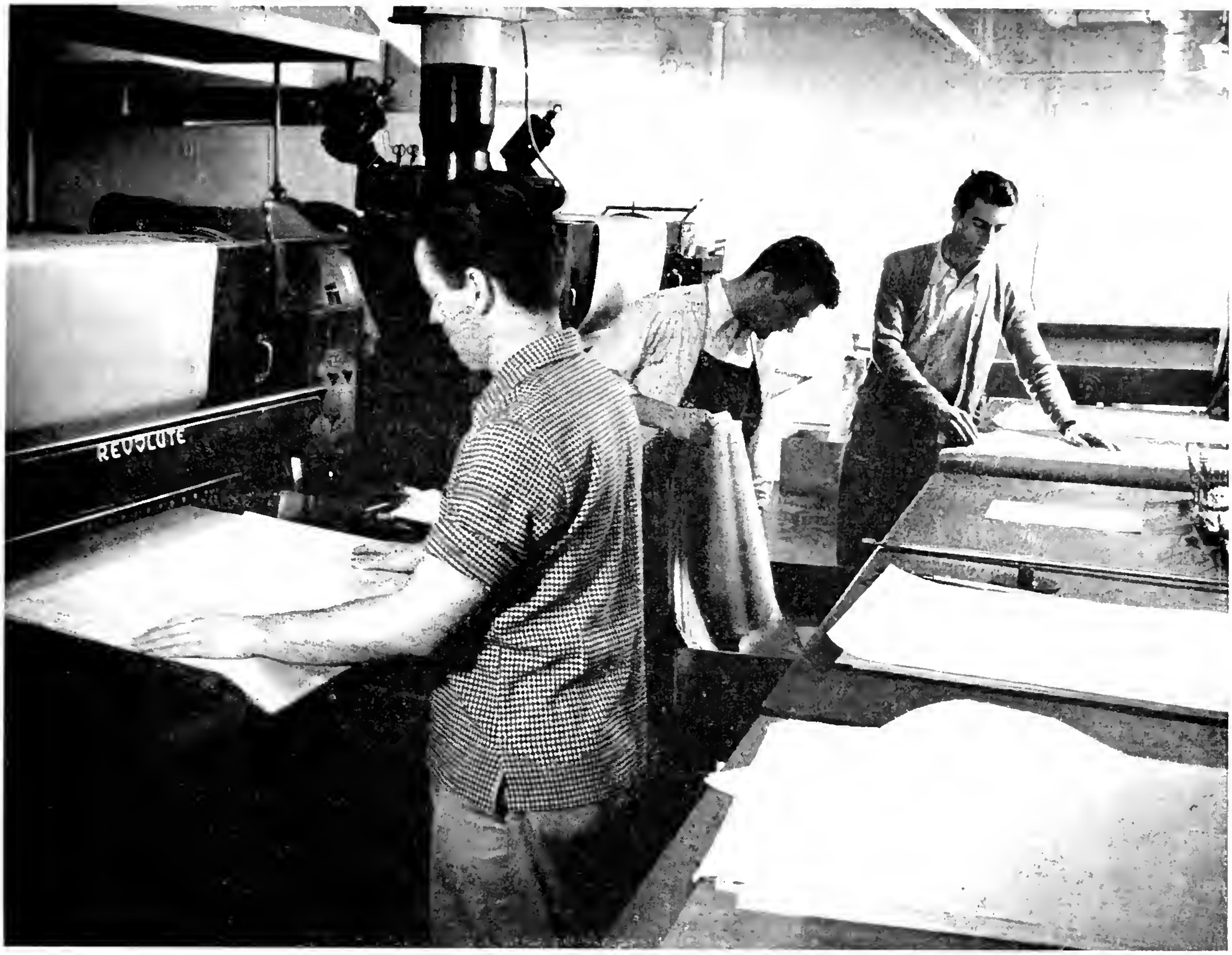
PITY THE DISTRICT ENGINEER

The average California motorist has no more difficulty making $5 do the work of 10 than has the Budget Department of the Division of Highways in stretching the gas tax income to meet the need. Both know it can't be done.

J. W. Vickrey, Assistant State Highway Engineer and Chief of the Planning Department of the Division of Highways, at head of table; with Harry L. Kile, Budget Engineer, on his right; and J. C. Womack, Assistant Planning Engineer, on his left; give sympathetic attention to the presentation of plans and programs by each of the 11 highway district engineers. An urgent need for over $200,000,000 worth of work has been presented.

"But," says Vickrey, "what can I do? We estimate that there will be but $96,000,000 available for highway construction for the next fiscal year. Not even a genius could make that do $200,000,000 worth of work."

C. H. Whitmore, District Engineer of District III, with headquarters at Marysville, the dejected looking fellow, and John P. Murphy, his assistant, know just what Vickrey means.



Feeding two continuous blueprint machines in Headquarters Reproduction Department. Machine in foreground running paper tracing at seven feet per minute

Reproduction Materials

Continued from page 47 . . .

on one or both sides. Reflex film functions in the same manner as any photographic reflex paper, the theory being that dark areas absorb light, and light areas reflect light. With reflex film a diazo light sensitive substance is used as sensitizer rather than a photographic emulsion, thereby eliminating the necessity of dark room, washing, and fixing tanks. This new product adds considerably to the versatility of the semimoist diazo type copying field.

Prints on any of these reproduction materials may be made by exposing to sunlight or artificial light. The earliest method followed was exposing the coated stock in a sun frame (like a picture frame) with the tracing between the glass and the print. Developing and fixing was done in small open trays. Although this method is still practical for remote locations where few reproductions are required, most processing is now done by machines equipped with arc lights or high pressure mercury quartz tubes as a light source. These machines handle rolls of paper from 18 inches to 54 inches wide at speeds from 6 lineal inches to 32 lineal feet per minute, and many models expose, develop, wash, fix and dry in one continuous operation with the prints emerging from the machine ready for use.

Reproduction Machines

The California Division of Highways has reproduction machines in 10 of its 11 districts as well as three machines in its Headquarters Reproduction Department. These machines range from those printing a few feet per minute to the most modern, high speed, continuous models. Almost 400,000 square yards (about 80 acres) of reproduction papers, cloth and film are used each year to convey the highway and bridge engineers' designs to the contractors' forces on the job.

For many years, reproduction materials were obtained from distributors through the State Purchasing Division as needed, at prices in excess of those paid by commercial reproduction establishments despite the fact that the California Division of Highways used a greater quantity than most commercial concerns. Research among the

present specifications used by commercial and governmental agencies failed to produce a satisfactory guide for the acquisition of these reproduction products. In order to produce specifications that were rational and consistent with present manufacturing practices an analysis of the results desired was undertaken and the following factors deduced.

Sensitive to Light

Blueprint and diazo reproduction materials are sensitive to light and moisture, so they must be well protected with light and moisture-proof wrappers until ready for use. Even when so protected, they should be stored in a cool dry place to prevent premature aging. If coatings are not carefully compounded, the materials may age rapidly even under ideal storage conditions and not produce satisfactory prints. This aging may become apparent in less than a month, whereas a good coating will not show any appreciable deterioration in four months or more.

A good reproduction material should give excellent prints when exposed to light for various lengths of time within reasonable limits. For example, a paper rated to print at 15 feet per minute should give acceptable prints from about $12\frac{1}{2}$ to $17\frac{1}{2}$ feet per minute. This range of speeds, within which acceptable prints are produced, is defined as the "latitude" of the material.

Water Resistant

The lines on prints should be water resistant as very often the prints are to be tinted with water color and working drawings are occasionally exposed to wet weather on the job. "Bleeding" of the lines under these conditions would be aggravating.

On the job in the field, prints are exposed to direct sunlight from time to time, so they must be lightfast, as fading would make them difficult to read.

As there were no specifications and tests to control these characteristics, the Stores Department of the Division of Highways tested and analyzed a great variety of reproduction materials in order to evaluate their qualities and determine standards consistent with the above needs.

Before any comparative tests could be made, it was found that a standard test tracing was necessary. It was decided to use a cloth tracing 11 inches by $8\frac{1}{2}$ inches with an opaque portion 4 inches by 6 inches and various weights of lines from .005 inch to .040

Operator feeding small paper tracings into continuous ammonia process printer in Headquarters Reproduction Department. Printing on cut sheets at 10 feet per minute

inch. This standard test tracing is described in detail in the specifications for diazo reproduction materials which are quoted in this article.

The principal apparatus developed to test the quality of the test prints is the "reflectometer." This apparatus measures the light reflected from a surface with the aid of a photoelectric cell. A ground milk glass is used as a standard and represents 100 percent reflectance, while a piece of black velvet represents zero reflectance.

Acceptable Print

Figure 1 shows typical curves of an acceptable print. The upper curve shows the contrast index at various printing speeds. Contrast Index as defined in the preceding specifications is the difference in reflectance, in percentage, between the exposed and unexposed portions of a test print. This figure also illustrates the latitude, previously defined, and in this case appears to be 7½ feet per minute. However, as shown by the lower curve, the discoloration of the paper due to uncleared coating, known as "Fog," reduces the latitude to a little over six feet per minute.

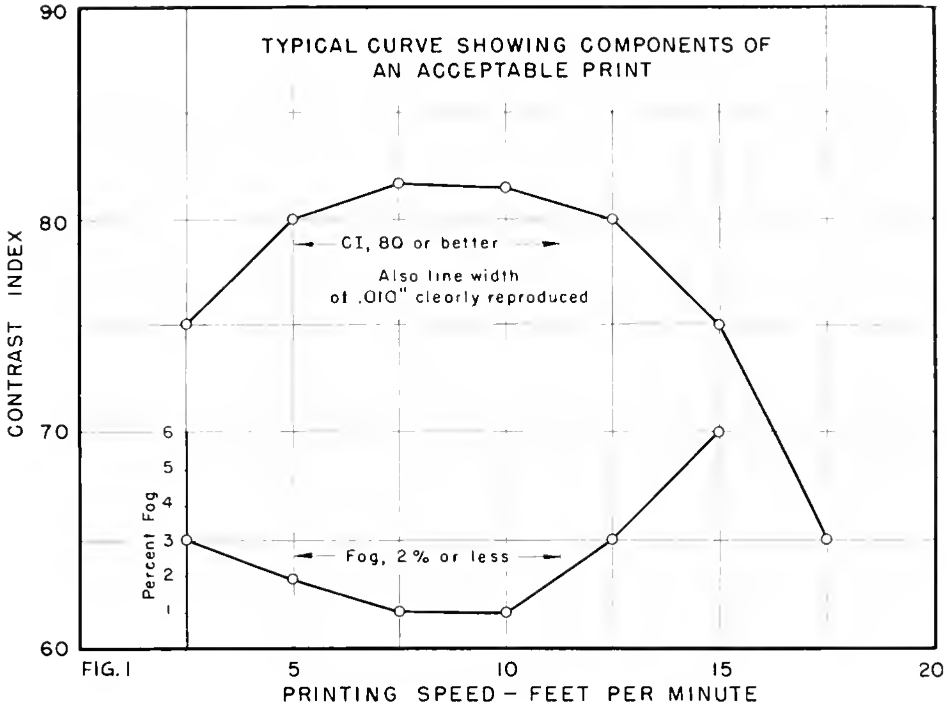


FIG. I

On the basis of the Division of Highways specifications, the Stores Department asked the Purchasing Division to call for competitive bids for one year's supply of diazo materials for the whole Division of Highways, to be delivered as requested. Contracts were entered into with two distributors, on the basis of their low bids and conformance of their materials with the above specifications. As a result a savings of over $4,400 on reproduction materials alone is expected for the year.

After observing the workability of the specifications and tests for several months, a few desirable changes are to be incorporated to broaden competition and obtain better materials.

The specifications are being revised to permit three percent of fog on prints on opaque paper. The provision that paper stock shall be 50 percent rag or better is being eliminated to permit the use of good sulphite paper. Experience has shown that rag content is not a definite criterion of a good paper.

Intermediate Prints

Prints are often made on transparent paper from which opaque prints can be made after revision or modification. Such prints on transparent paper are called intermediates. A new important provision is to be included requiring that prints from intermediates must be acceptable when intermixed with cloth tracings of good quality, using a continuous printing device without changing speed of printing and without using any transparentizing treatment. An opacity test is to be added to evaluate this characteristic.

The Stores Department has also written specifications for blueprint and blueline materials similar to those for diazo products and is conducting research on negative papers to obtain data from which specifications may be prepared.

Saving of Money

The above detailed study exemplifies the engineering approach, study and results as applied to manufactured products used in highway construction. Considerable research and study has been given to materials such as asphalts, cements and aggregates entering directly into construction work, but only since the advent of the Stores Department has the same type of engineering effort been applied to manufactured products, which are necessary accessories to highway construction. It is the present objective of the Stores Department to render this engineering service to all commodities purchased from manufacturers with a consequent savings of highway funds and a decided improvement in quality of products purchased. Fundamentally, Stores Department engineers are continually seeking to acquire the maximum quality for each dollar expended. Each dollar saved means an additional dollar for highway construction and improvement.

Specifications for Reproduction Paper

After exhaustive tests and analyses, the following specifications for diazo reproduction materials were prepared by the Stores Department in conjunction with the Materials and Research Laboratory to obtain the best possible results consistent with cost and our needs. In this work, the engineers of the Stores Department received the close cooperation of Mr. Glen Morgan, Assistant Physical Testing Engineer of the Materials and Research Department, who performed much careful and painstaking work. The Headquarters Reproduction Department also cooperated by making its equipment available for producing test prints.

SCOPE

This specification covers reproduction papers suitable for use in commercial, continuous process printing machines using the dry ammonia vapor developing system. The paper is to be used in the "Ozalid Print Master Machine," Model B, Model F, or Streamliner. All test prints are to be made on a Model B machine at full light intensity.

DEFINITION OF TERMS

Fog—The discoloration of the paper stock due to uncleared coating shall be known as fog.

Contrast Index—The difference in percent reflectance between the exposed and unexposed portion of a test print which has been fully developed.

Latitude—The exposure range at which acceptable prints are obtainable, expressed in feet per minute.

Shelf Life—Maximum age of paper, from date of shipment by California distributor, which will produce an acceptable print.

Lightfastness—Resistance to fading, discoloration or fogging due to sunlight.

Water Resistance—Resistance to "bleeding" or "running" of any portion of the print due to the solubility of the fixed dye.

Standard Test Tracing—The standard test tracing shall be made on a good quality of cloth and shall be eight and one-half by eleven inches. A portion four by six inches shall be opaque. (This is best done by attaching a sheet of black opaque paper to the tracing with a strip of scotch tape.) A series of lines shall run across the tracing, one each of the following width, .040", .020", .010" and .005", correctly labeled. Directly underneath these lines, the following line of printing shall be made with a Leroy lettering pen, size of pen, 00; size of template, 100 (or equal), "Department of Public Works Division of Highways, Sacramento 16, California." A standard waterproof India ink shall be used.

Acceptable Print—A print from the standard test tracing that clearly reproduces a line width of .010" having not more than two percent of fog and a Contrast Index of not less than 80, is an acceptable print.

SPECIFICATIONS

Fog—The cleared portion of the test print shall have not more than two percent fog.

Speed—The printing speed shall not be less than 5 nor more than 15 feet per minute.

Contrast Index—The contrast index shall not be less than 80.

Latitude—The latitude of printing shall not be less than 5 feet per minute.

Shelf Life—The shelf life shall not be less than four months.

Lightfastness—Reduction of contrast index due to sunlight, not more than 10, increase in fog not more than 5 percent.

Water Resistance—When tested as herein described, reflectance of the test specimen shall not be reduced by more than 10%.

Intermediate Paper—Sensitized paper to be used for making temporary or intermediate translucent tracings shall comply with all of the above specifications except those for Water Resistance and Latitude. In addition, the intermediate tracing made from this type of paper must produce an acceptable print.

Paper Stock—The paper stock shall be 50 percent rag or better and of a uniform quality free of any defects that in any way affects the serviceability of the paper, or the uniformity of the sensitized coating. Reproduction paper shall be suitable for use in commercial, continuous process printing machines using the dry ammonia vapor.

Packaging—Each roll shall be one continuous piece and wrapped in a moisture and light proof covering. Sheets shall be similarly protected.

Packing—Unless otherwise specified the commodity shall be delivered in standard commercial containers so constructed as to insure acceptance by common or other carriers for safe transportation, at the lowest rate, to the point of delivery.

Marking—Each roll shall be labeled with the name of the material, the type, class, brand, weight, width, lot number and yardage contained therein.

Each roll or package shall be plainly marked with the date of shipment. This date shall be used to compute the shelf life.

General—Failure to comply with any of these specifications will be cause to reject a bid.

Material will be tested at various times after delivery and any defective paper found in a shipment must be replaced without cost by the vendor.

TEST METHODS

Sampling—Not less than 50 sheets 8½ x 11 inches of each weight and type shall be submitted with the bid as representative of the material to be delivered. Sample sheets shall be properly packaged and labeled.

All tests are to be made by the Division of Highways, Materials and Research Department, Sacramento, California.

Reflectance—All reflectance measurements are to be made with a suitable photoelectric measuring device, provided with a filter to correct the spectral response of the photocell to that of the standard observer curve.

A ground milk glass panel is used as a standard and represents 100 percent reflectance and a piece of black velvet as zero reflectance.

All reflectance measurements are to be made upon a single sheet backed up with the standard ground milk glass panel. Readings are made 24 hours after exposure.

All tests are to be made in triplicate and the average value reported.

Contrast Index and Latitude—A series of prints are made with the standard test tracing using a range of exposures that will produce both under and over exposed prints. Exposure steps of approximately two feet per minute shall be used. It is desirable to plot the contrast index against the exposure in feet per minute. From this curve, the Latitude of the paper is established in accordance with the definition of an acceptable print.

Fog—The reflectance of the back of the cleared portion of a fully exposed and developed test print is to be considered as the maximum reflectance of the paper.

The difference between this figure and readings taken on the cleared portion of the test prints shall be known as fog and reported as percent.

Shelf Life—The shelf life of the paper is to be determined as outlined:

Unexposed sheets are to be conditioned at 70° F. ± 2°, 50 percent relative humidity ± 5 percent for 24 hours. The paper is then placed in a moisture, lightproof container and placed in an oven maintained at 120° F. ± 1° for 72 hours.

After cooling to room temperatures test prints are made at optimum exposure and the contrast index shall not have been reduced by more than 10 nor the fog increased by more than 5 percent.

Water Resistance—A series of lines, .050" wide and .100" apart are drawn with a standard waterproof India ink on an 8½ x 11 inch tracing cloth of good quality. An area of 4 x 6 inches is covered with this gridwork of lines. Prints are made at optimum exposure, and the reflectance of this gridwork is measured. The test prints are dipped five times, two seconds each dip, into distilled water, in such a manner that the lines are horizontal. Drain for five seconds after each dip. After drying, the reflectance is again measured and the difference is reported in percent.

Lightfastness—Test prints shall be exposed to a G. E. S-4 bulb operating at a primary voltage of 115 volts A. C. ± 2 volts. The bulb is used without a reflector, the prints being placed on the inside of a slowly revolving cylinder 18" in diameter. This test is to be made at 70° F. ± 2; 50 percent relative humidity ± 5 percent.

Exposure shall be for 10 hours. The contrast index shall not be reduced by more than 10 nor the fog increased by more than 5 percent.

Uniformity of Coating—Three sheets are developed to produce maximum color and examined for defects in coating and shall be reported as satisfactory or unsatisfactory.

EARL WARREN
Governor of California

•

CHARLES H. PURCELL
Director of Public Works

•

FRANK B. DURKEE
Deputy Director

•

HIGHWAY COMMISSION

C. H. PURCELL	Chairman
HARRISON R. BAKER	Pasadena
HOMER P. BROWN	Placerville
JAMES A. GUTHRIE	San Bernardino
F. WALTER SANDELIN	Ukiah
CHESTER H. WARLOW	Fresno
CHARLES T. LEIGH	San Diego

DIVISION OF HIGHWAYS

GEO. T. McCOY	State Highway Engineer
FRED J. GRUMM	Deputy State Highway Engineer
J. G. STANDLEY	Assistant State Highway Engineer
R. M. GILLIS	Assistant State Highway Engineer
F. W. PANHORST	Assistant State Highway Engineer
J. W. VICKREY	Assistant State Highway Engineer
R. H. WILSON	Assistant State Highway Engineer
T. E. STANTON	Materials and Research Engineer
GEORGE F. HELLESOE	Maintenance Engineer
C. E. WAITE	Engineer of Design
EARL WITHYCOMBE	Construction Engineer
H. B. LA FORGE	Engineer of Federal Secondary Roads
L. V. CAMPBELL	Engineer of City and Cooperative Projects
EARL E. SORENSON	Equipment Engineer
H. C. McCARTY	Office Engineer
J. C. YOUNG	Traffic Engineer
J. C. WOMACK	Planning Engineer
I. O. JAHLSTROM	Principal Bridge Engineer
STEWART MITCHELL	Principal Bridge Engineer
E. R. HIGGINS	Comptroller

Right of Way Department

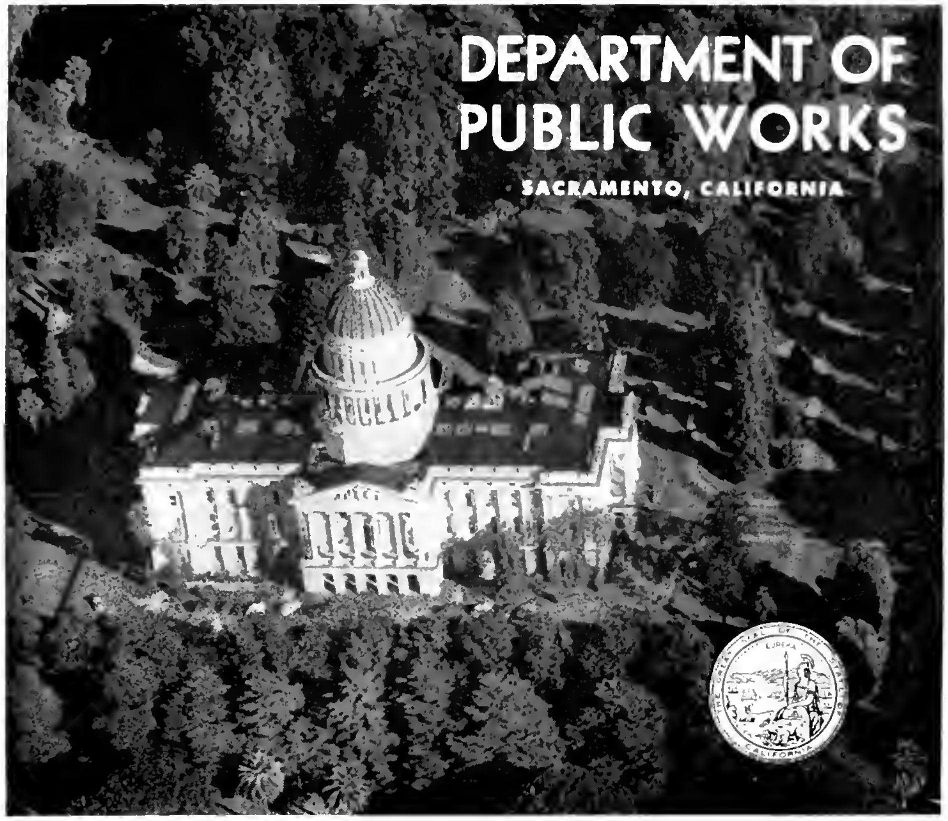
FRANK C. BALFOUR	Chief Right of Way Agent
E. F. WAGNER	Deputy Chief Right of Way Agent
GEORGE S. PINGRY	Assistant Chief
R. S. J. PIANEZZI	Assistant Chief
E. M. MacDONALD	Assistant Chief

District IV

JNO. H. SKEGGS	Assistant State Highway Engineer

District VII

P. O. HARDING	Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

A. M. NASH	District I, Eureka
F. W. HASELWOOD	District II, Redding
CHARLES H. WHITMORE	District III, Marysville
B. W. BOOKER	District IV, San Francisco
L. A. WEYMOUTH	District IV, San Francisco
E. J. L. PETERSON	District V, San Luis Obispo
E. T. SCOTT	District VI, Fresno
W. L. FAHEY	District VII, Los Angeles
M. E. CESSNA	District VII, Los Angeles
E. Q. SULLIVAN	District VIII, San Bernardino
S. W. LOWDEN	District IX, Bishop
JOHN G. MEYER	District X, Stockton
E. E. WALLACE	District XI, San Diego
HOWARD C. WOOD	Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

C. R. MONTGOMERY	Chief
ROBERT E. REED	Attorney
GEORGE C. HADLEY	Attorney
HOLLOWAY JONES	Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR	Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON	State Engineer, Chief of Division
P. H. VAN ETTEN	Assistant State Engineer
W. H. HOLMES	Principal Engineer, Design and Construction of Dams
G. H. JONES	Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. R. SIMPSON	Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL	Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER	Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON	Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER	Principal Attorney
T. R. MERRYWEATHER	Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD	State Architect
W. K. DANIELS	Assistant State Architect (Administrative)
P. T. POAGE	Assistant State Architect (Design and Planning)
D. C. WILLETT	Chief Construction Engineer

Headquarters

A. F. DUDMAN	Principal Architectural Designer
C. L. IVERSON	Supervising Architectural Draftsman
CARLETON PIERSON	Supervising Specification Writer
FRANK A. JOHNSON	Principal Structural Engineer
C. A. HENDERLONG	Principal Mechanical and Electrical Engineer
WADE HALSTEAD	Supervising Estimator

SCHOOLS

W. H. PETERSEN	Principal Structural Engineer, Sacramento
H. W. BOLIN	Principal Structural Engineer, Los Angeles

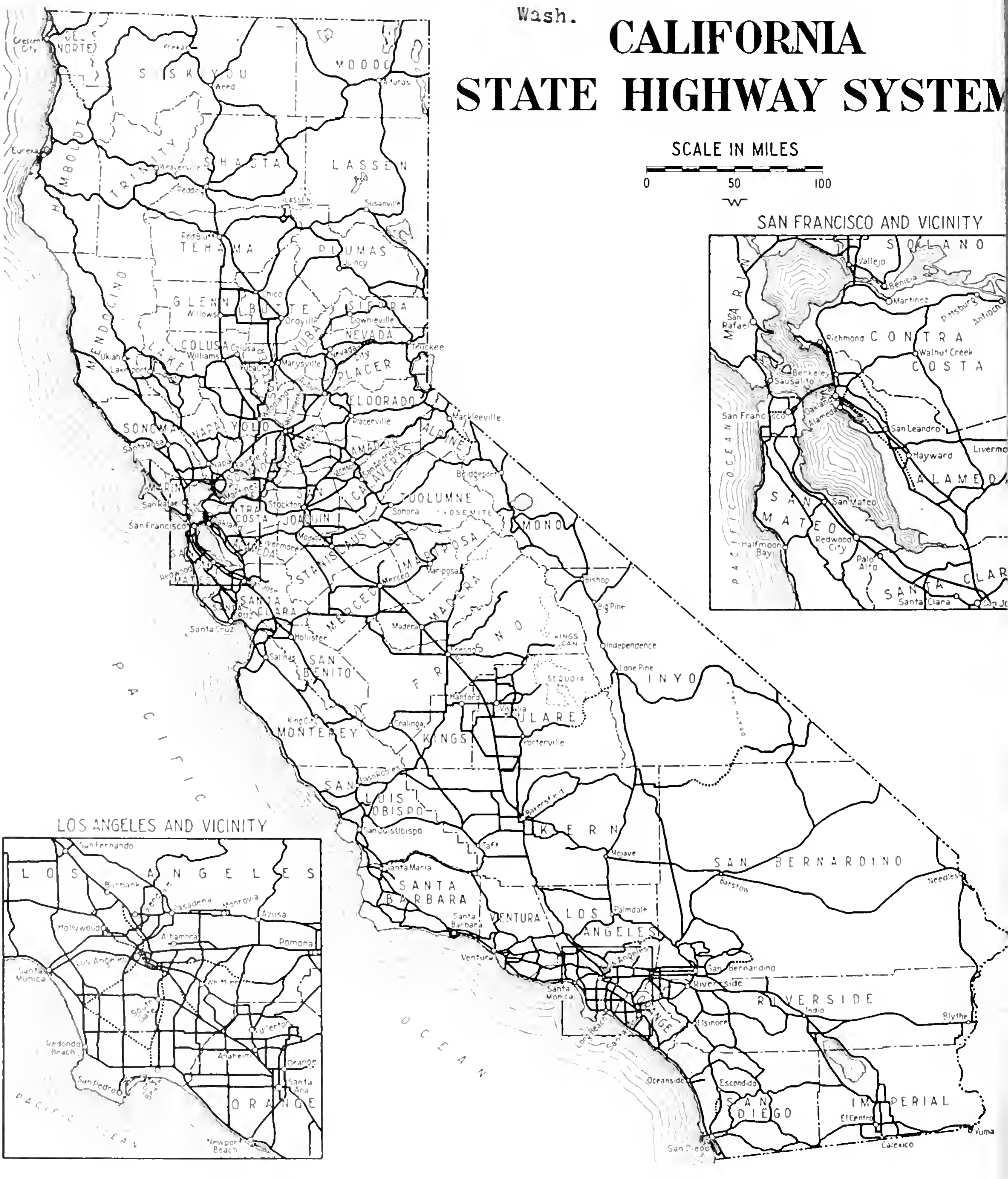
printed in CALIFORNIA STATE PRINTING OFFICE 22400 3-50 26M

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA
RETURN POSTAGE GUARANTEED

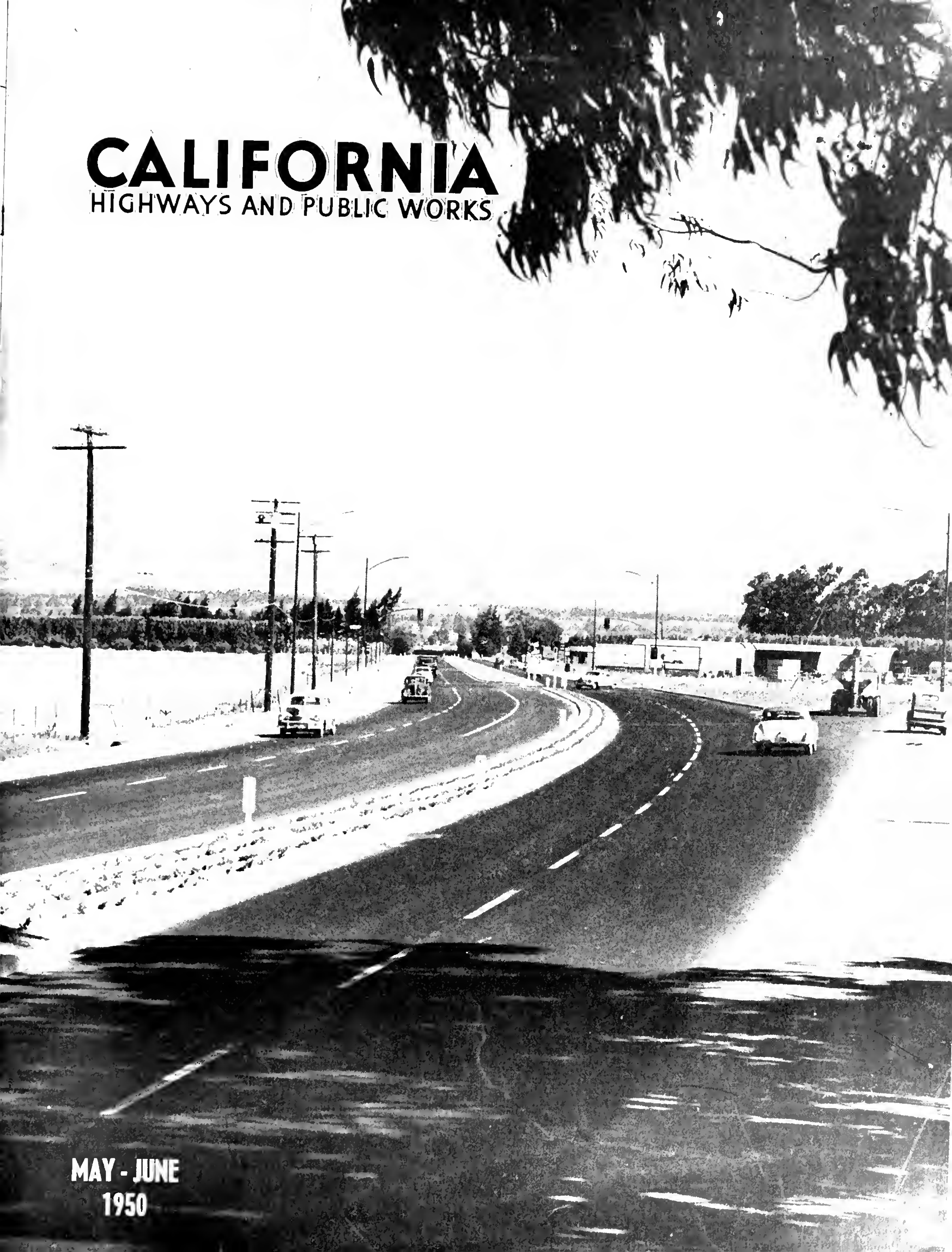
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

Seattle Public Library,
Seattle,
Wash.

CALIFORNIA STATE HIGHWAY SYSTEM



CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



MAY - JUNE
1950

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director* — GEORGE T. McCOY, *State Highway Engineer*

KENNETH C. ADAMS, *Editor*

HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 — May-June — Nos. 5, 6

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

Auburn Study

Economic Survey of Placer County Freeway Shows Business Benefits

By W. STANLEY YOUNG, Headquarters Right of Way Agent

BY-PASSING the business section of the mountain city of Auburn, Placer County, two years ago with a freeway presented the Division of Highways with an excellent opportunity to learn what effects on business and property values can reasonably be expected whenever the typical small highway city has nonbuying through traffic removed.

By studying the volume of traffic on the highway and within the city before and after installation of the freeway and comparing the volume of retail business of all businesses to a wider base during a two-year period before and following the freeway opening, as well as consideration of all the real estate sales and other influencing factors, it has been possible to evolve a fairly accurate answer to the question of what effects a freeway installation around a city has on the retail businesses and property values.

Serves Recreational Motorists

Typical of many small cities along our highways throughout the State, Auburn has depended on agriculture as its principal source of income, but supposedly also with considerable reliance on the stream of highway traffic which had previously passed along its main streets.

Being a gateway to the Lake Tahoe recreation area with its two seasons of appeal—skiing in winter and vacationing in summer—as well as located on a main transcontinental route, Auburn was in an excellent position to derive considerable income from services to travelers. That this income is of considerable significance is evidenced by the number of cafes, bars and service stations existing within this city of under 5,000 population as well as by the type and quantity of merchandise, such as ski togs, camping supplies, fishing tackle and hunting equipment which is stocked in the various stores, well in excess of local needs.

Many vacationists and ski enthusiasts from the San Francisco Bay area were regular customers of the Auburn merchants, probably because of the friendly service and availability of a wide selection of recreation goods, and also because Auburn is about half way in driving time between Lake Tahoe and the Bay area.

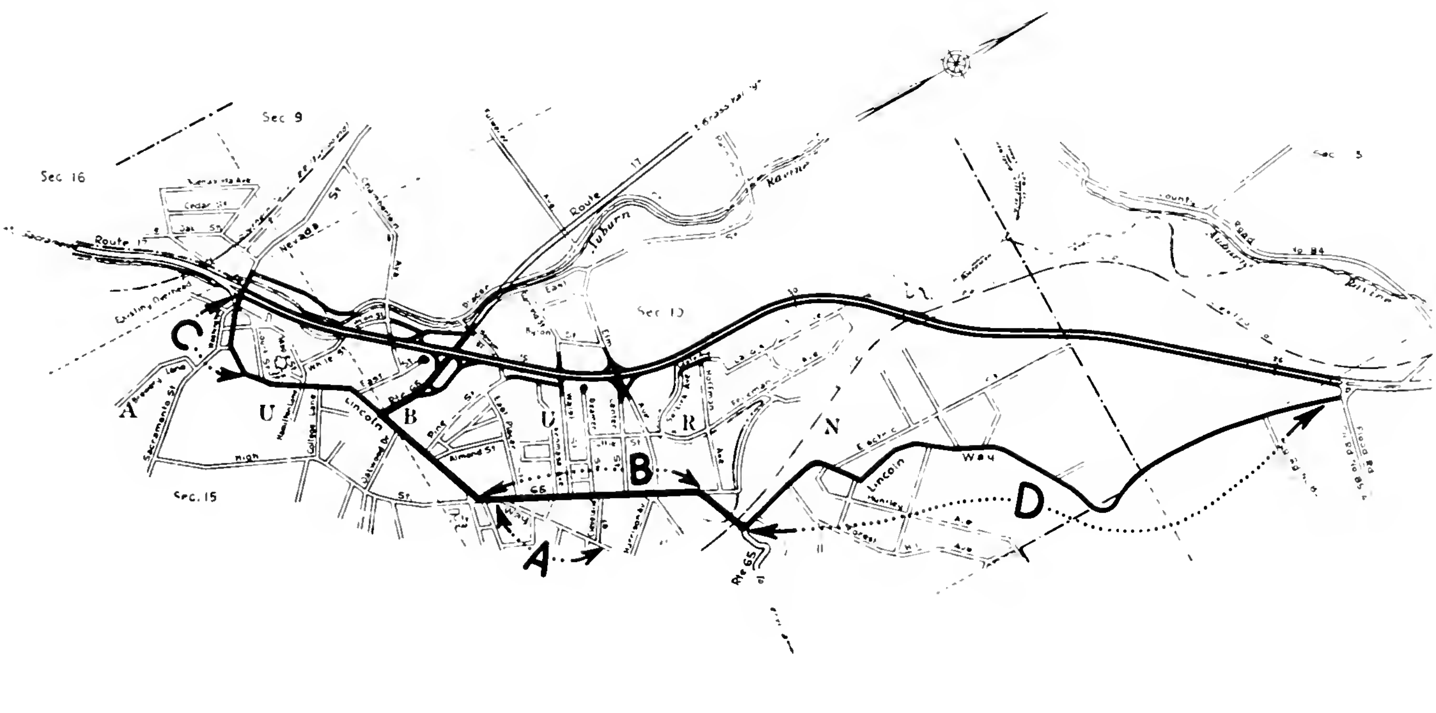
Business Benefited

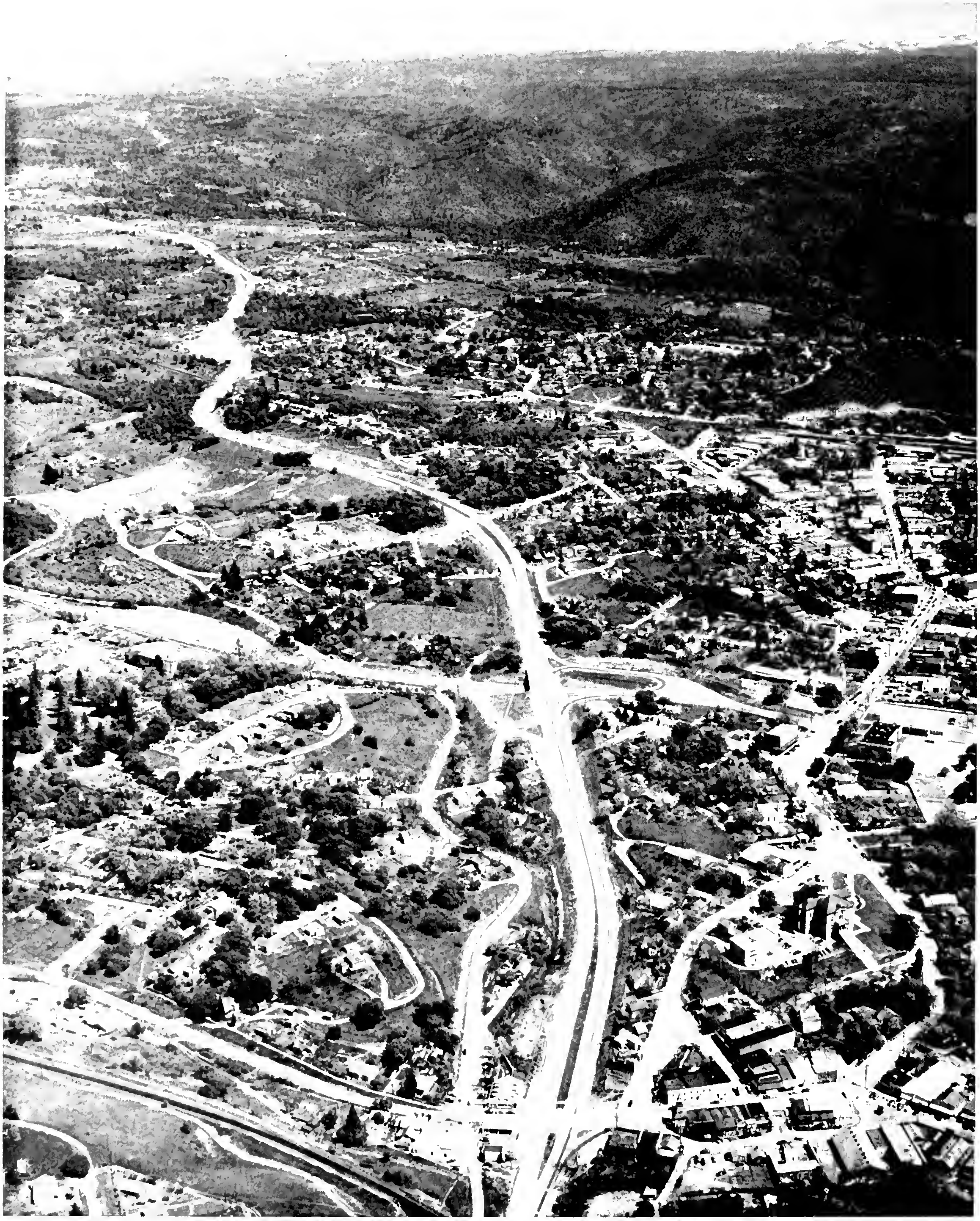
What would be the results of the installation of the freeway completely by-passing the business section of Auburn? Very few people in Auburn doubted that it would benefit the city generally, but many feared for the businesses of service stations, cafes and bars which supposedly were deriving a considerable portion of their income from the nonlocal motorist.

This expectation appears to be rather generally held—especially by those persons not operating these particular types of business.

Our completed factual study, in which all the retail sales of the stores along the main streets in Auburn during the two-year period preceding opening of the freeway and the two-year period following its opening, are compared to the state-wide average for each type of business, has definitely established that all types of busi-

Map showing the old and new routes through Auburn. Sections A and B represent the center of business activity. Section C is the old section of Auburn near the freeway. Section D is the section which is utilized for both commercial and residential purposes





ness were benefited by removal of the non-buying traffic from the congested city streets.

While all retail business in the State as a whole showed an increase of 14 percent since the end of 1947, the over-all volume of business in Auburn increased 17 percent.

Service Stations Helped

Service stations disclosed the greatest benefits due to the freeway by registering a gain of 17 percent in gross retail sales compared to a loss of 4 percent on the state-wide average. However, the number of gallons of gasoline sold to service stations in Auburn during the two years following the freeway opening paralleled almost exactly the state-wide average by showing a 10 percent drop in volume sold.

Consideration of the general volume of traffic in the vicinity of Auburn as compared to traffic volume throughout the State is necessary in order to appreciate the fact that Auburn service station gallonage did not drop well below the state-wide gallonage figures.

There was approximately a 10 percent drop in traffic in the vicinity of Auburn (both on and off the highways) as compared to a 12 percent rise in the traffic count in the State as a whole so that, if the ratio of traffic to gallons of gasoline sold remained fairly constant, the reasonable expectancy was a severe drop in gasoline sales in Auburn, all other factors being unchanged in relationship.

Despite this poor outlook, service stations, as stated before, far outstripped service stations on the average throughout the State in retail sales and compared favorably in number of gallons of gasoline sold.

General Business Increase

Cafes and bars, when compared to the state-wide average, also were found to be in a better position in spite of a poorer expectancy based on general local economic conditions. During the two-year period cafes and bars in Auburn averaged a 6 percent loss in gross volume while the state-wide figure was an 11 percent loss.

The classification, "All other businesses," which includes drug, department, variety, grocery, apparel stores and the like, enjoyed an increase of 20 percent in gross volume of business, which was exactly the same as the gain registered by these businesses throughout the State.

Of considerable interest in this category is the story of one prominent chain store firm with department stores in both Auburn and Grass Valley, a city very comparable to Auburn in size, sources of income, and all general characteristics, except that Auburn was situated astraddle of a more heavily traveled highway. This company disclosed comparative gross sales figures of its store in each city during the two-year period before and the two-year period following the freeway.

It was found that prior to the freeway the Grass Valley store had been running about 5 percent more in gross sales volume than the store in Auburn. At the precise time that the Auburn freeway opened the comparison between these stores almost exactly reversed, so that the Auburn store has since been grossing consistently approximately 5 percent more than the Grass Valley store.

Other Factors

The excellent trend of retail business in Auburn becomes even more apparent when the other factors in business fluctuations are compared to the same factors on a state-wide basis.

Population in the vicinity of Auburn based on assessment rolls, school enrollment, employment rolls and Chamber of Commerce estimates, has increased between 5 and 6 percent. During this same time the State's population increased more than 11 percent.

While dollar pay-rolls in the Auburn vicinity only increased 10 percent the pay-rolls within the entire State increased 13 percent.

In addition to these factors which were below the state-wide average, there has been a decrease in use of the recreational facilities in the region as evidenced by the 10 percent drop in traffic along the highway and reports of resort owners in the region.

Aerial view looking northeasterly from the westerly end of the freeway. The superseded route is the street to the right of the freeway which meanders through the city to a junction with the freeway near the upper left-hand corner of the picture. Main business is in the right of the picture

New Livingston building abutting former highway (Section B of map). Stores are featured both at street level and on the second floor with entrances from a long hallway

UPPER Scene in historic old section of Auburn near the westerly city entrance from the freeway. All highway and local traffic formerly used this street. (Section C of map.) LOWER Street scene during midday, showing normal parking and traffic conditions in the business section of Auburn. (Sections A and B of map)

Court Decisions on Highway Law Awaited

Litigation of great importance to the Department of Public Works in connection with modernization of the California State Highway System was decided in the appellate courts during the last week of April.

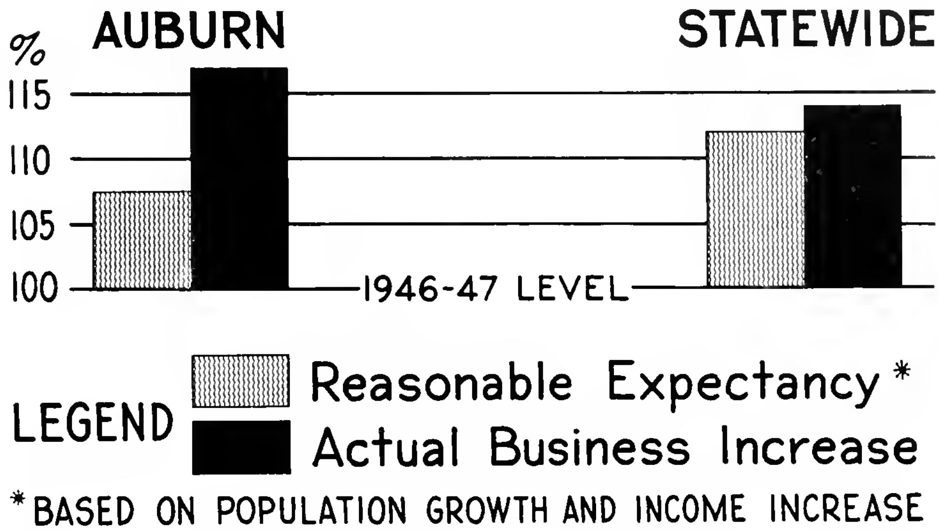
In *Holloway* v. *Purcell*, arising out of the proposed relocation, as a freeway, of the state highway (U. S. 40) between North Sacramento and Roseville, in Sacramento and Placer Counties, the Supreme Court decided that the California Highway Commission has authority to approve the relocation of state highways, including highways constructed or acquired under the State Highways Act of 1909 (the original state highway bond issue), and in the same case also decided that the Freeway Law is valid and constitutional.

A petition for a rehearing has been filed by the appellants.

In *Holman* v. *the State of California*, an inverse condemnation action growing out of reconstruction of the state highway (U. S. 99) through Bakersfield, the Fourth District Court of Appeal decided that the placing of a physical center dividing strip in the highway, as a safety measure to prevent left-hand turns, was a valid exercise of the police power and that abutting property owners were not entitled to damages by reason of the improvement of the highway in such a manner.

It is expected that the decisions in these cases will have become final prior to the July-August issue of *California Highways and Public Works*, and a comprehensive review of the opinions in both cases will be presented in that issue.—EDITOR.

GROSS VOLUME OF BUSINESS SINCE FREEWAY



Another contributing factor was the severe drop in income from 1949 fresh fruit sales, which is one of the two main sources of agricultural income in this principally agricultural community.

State-wide Average

Despite these several factors which would rather clearly predict a substantially poorer business trend than the statewide average, each type of business in the City of Auburn fared at least as well as, and in many cases, better than the statewide average.

Reason for the selection of the statewide figures as a yardstick to measure the effect of the freeway on the City of Auburn is that it was found to follow more closely than any other available base the business trends of Auburn during the years preceding the freeway, and therefore the same relationship could be expected to exist following opening of the freeway unless a substantial variation in the major contributing factors occurred.

Gross Retail Sales

In weighing the relative merits of increasing gross retail sales or number of gallons of gasoline sold, it is obvious that the net profit would be greater in the case of a retail sales increase due to the much higher mark-up percentage in sales-taxable items than gasoline. Conversely, any loss in gasoline gallonage would result in a smaller dollar loss in net profit than the same percentage-wise loss in gross retail sales.

In further studying the retail sales of the Auburn merchants and also considering the volume of traffic within the city before and after opening of the freeway, it is clear that very few, if any, former customers have forsaken Auburn establishments as a result of the freeway installation.

Traffic in the City of Auburn dropped approximately 11 percent on weekdays after the freeway opening, which corresponds closely to the 10 percent drop along the highway during the same period. Traffic on Sundays within the city dropped 20 percent.

Increase in Shoppers

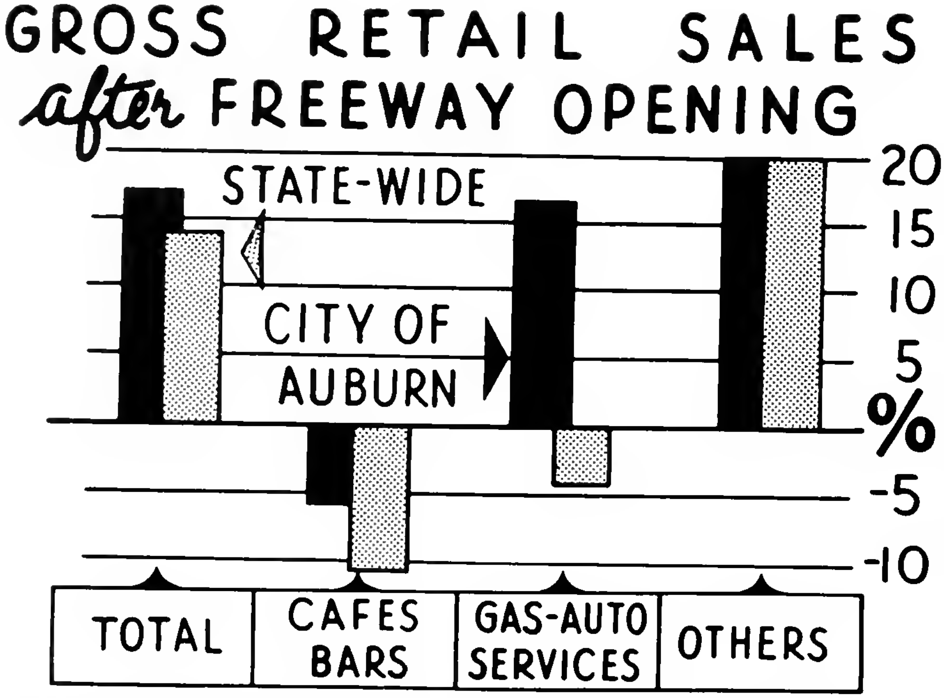
Despite the traffic drop along the main streets of the city, parking meter returns, as well as heavier use of city-provided free parking lots, indicates an increase in number of shoppers by automobile. This is reflected in the over-all increase in retail sales of 17 percent.

The thorough analysis of all important factors contributing to business fluctuations in Auburn has conclusively established that the freeway installation, by its removal of non-buying traffic from the city streets, has benefited retail business along the former state highway.

Real Estate Trends

How have real estate values along the by-passed section fared since the building of the freeway?

In analyzing all of the 66 sales of real estate which have occurred since the beginning of 1945, it was not possible to plot graphically the increase or decrease in values on a before-and-after basis, as was accomplished in our



Fresno and North Sacramento freeway studies, because very few properties sold twice during the period of the study. However, the three before-and-after sales of business property which did occur indicated increases in value of 61½ percent, 21 percent, and 20 percent.

Nor was it possible to develop the 23 sales of vacant property into a precise graphic curve because of the wide differences in value along the by-passed section. Most of the downtown business property sales occurred during the construction of the freeway.

During this period of activity the highest prices ever paid per front foot in the city were recorded—by business men of many years' residence there.

Property Values Up

These properties, with values ranging from $300 to $375 per front foot, have since been improved with the most modern and attractive store buildings in the city. Pictures of some of these new buildings which would be a credit to any city of any size, are shown on these pages.

Inasmuch as the geatest activity and highest prices in business property were during 1947 while the freeway was under construction, at which time all of the first-class vacant property was bought up, the confidence of the local merchants in the benefits from the freeway are evident. This fact was borne out in our interviews with these business people.

Because of the varied character of the property along the superseded section of highway, the effects on the various components are more easily explained by reference to the map which is reproduced on these pages showing the new freeway route and the by-passed route through the city.

. . . Continued on page 62

Scene showing modern building constructed since the freeway of the 100 percent business location. (Section A of map)

PROGRESS OF CALIFORNIA FREEWAY PROGRAM

By HARRISON R. BAKER, Member California Highway Commission

It has now been five years since Governor Earl Warren called the attention of the California Legislature to the pressing need for the reconstruction and modernization of the California Highway System in order to meet the demands put upon it by the great increase of population in California and the consequent strain on our highway facilities. Governor Warren particularly pointed out the need for an integrated system of freeways to solve the traffic problem over the heavily traveled main arteries, with special emphasis upon the metropolitan areas.

The California Legislature, following the report of its interim committee, passed the Collier-Burns Highway Bill in 1947 augmenting the financing available for the construction of the highway and freeway program in California.

First Two Years

The California Highway Commission has now completed two years of construction under the increased highway program made possible by the Collier-Burns Bill and we are now entering into the third year of construction under this program. In the light of this experience it is appropriate to review the scope and size of the task presented in this modernization program of the California Highway System, with particular emphasis on the freeway program, to review what has been accomplished to date in carrying out this construction program, and to outline some of the problems which have developed and which need a more adequate solution provided this program is to operate efficiently and in the best interests of carrying forward this highway and freeway modernizarion program.

Enormous Task

The size of the task of modernizing the highway system and building an integrated system of freeways is enormous. What has been accomplished to date only emphasizes the tremendous scope of this problem and the great need for its solution. The continued grow of the population of California, with the attendant increase of motor vehicle registrations, continues to accentuate and aggravate the traffic congestion problem requiring solution by bringing our State Highway System up to rhe standard needed to handle the demands put upon it.

Harrison R. Baker

The 1940 population of California was slightly over 7,000,000 people. In 1950 the estimated population is 10,875,000, an increase of 57 percent. In 1939 our motor vehicle registration was approximately 2,800,000 and in 1950 it is in excess of 4½ million, an increase of 63 percent, incomparably the greatest of any state in the Union.

Construction Costs

From the standpoint of the cost of construction, our California highway construction cost index shows that using 1940 as a base of 100, construction costs today stand at approximately 179. This is a decline from the high point reached in 1948 of 216, but it indicates that it still requires almost $1.80 in 1950 to accomplish work that would have cost $1.00 in 1940, the increase being approximately 80 percenr.

Since the passage of the Collier-Burns Highway Bill in 1947, the added financing made available to the California Highway Commission by this act has been actively put to work toward the solution of the highway and freeway problem in California. An examination in the field will reveal many miles of completed divided highways and freeways and many more miles under construction. However, the size of the task to be accomplished, as compared with the completed program to date, only emphasizes the scope of the problem and the fact that it will require a considerable period of time to carry this modernization program through to completion.

Freeway Mileage

With respect to the freeway program in California, as of September 1, 1945, we had a total mileage of declared freeways of 588.8 miles; as of January 1, 1950, this total declared freeway mileage is 1,440.3 miles. In California, at the start of the current fiscal year, we had 626 miles of completed freeway on the State Highway System of which 346 miles had been completed since the war.

Turning to the freeway picture in the southern 13 counties, which comprise the Southern California group, the California Highway Commission has authorized and the Division of Highways has completed or has under construction a total of 260.3 miles of freeway. In the postwar period from November, 1945, to March, 1950, the construction cost of this group of freeways in Southern California has been approximately $93,400,000 not including the cost of right of way.

Breakdown by Counties

A breakdown of this freeway construction by counties is as follows:

County	Miles	Construction cost (not including right of way)
Tulare	12.9	$2,496,000
Kern	18.3	4,942,000
San Luis Obispo	9.7	4,287,000
Santa Barbara	18.8	5,933,000
Ventura	8.0	2,733,000
Los Angeles	85.6	52,644,000
Orange	12.8	1,708,000
Riverside	9.0	1,795,000
San Bernardino	47.5	7,035,000
Imperial	13.1	1,724,000
San Diego	24.6	8,103,000
Totals	260.3	$93,400,000

For the ensuing 1950-51 Fiscal Year the California Highway Commission has budgeted for construction of state highways in Southern California a total of $34,116,000. Of this total, $24,673,400 or 72 percent is allocated for the construction of freeways. Right of way costs are not included in the above figures.

Freeways Cost Money

As an example of the heavy cost and extreme difficulty of completing freeways in the closely built-up metropolitan areas, I might cite the following example: The estimated cost of completing that portion of the Hollywood Freeway 2.8 miles in length between Grand Avenue and Virgil Avenue is $17,480,400 or $6,243,000 per mile. Nearly one-half, or $8,342,000, of this was for right of way. There were 20 separation structures required in this 2.8 miles, built at a cost of $5,913,400.

In addition to solving traffic congestion and delays, one of the major objectives of the freeway program has been the safety factor and the endeavor to reduce accidents and protect human lives. The record of the use of the parkways, which have been opened to travel, has shown the benefit of the safety features built into these modern freeways by our highway engineers. The average fatality record per one hundred million vehicle miles on our rural State Highway System is approximately 13.3. The same record on the Arroyo Seco Parkway for the period 1941 to 1949 indicates a factor of 1.9, showing that the fatality record on this parkway is only about 1/7 of the state-wide average and, as compared with an ordinary city street carrying the same volume of traffic, this comparison would be even more favorable to the freeway type of construction.

Cooperation Required

The enumeration of the accomplishments to date is not given with the idea of emphasizing their importance but rather to stress the scope and the size of the required freeway program and the need for cooperation and assistance by all interested citizens and groups who are familiar with the urgent need for expediting the freeway program.

From the experience to date in the unfolding and development of the freeway program, several aspects of the problem presented become increasingly apparent and must be given serious consideration.

First, from the standpoint of the State Highway Commission, there is the necessity for *a continued program of public education* as to the urgent need for highway modernization and the freeway system in California, and the desirability of expediting its construction. The impact of a highway construction program in California amounting to between $85,000,000 and $90,000,000 per year is so great and widespread in its effect upon individuals and communities that it is important that the public be informed, insofar as possible, of the need for this freeway program, the plans being made for its solution, and the desirability of the use of the freeway as a means of solving this problem.

Program of Education

The construction of freeways is a relatively new development in highway engineering. As the public becomes more accustomed to the use of freeways and more conversant with their use and effect upon the local communities, many of the problems which now appear to loom as serious objections will be dissipated, and the desirability and advantages of freeways will become more apparent and more universally understood. Meanwhile, from the State standpoint, there is the need for *a continued program of education and an improved public relations policy* in respect to the planning and development of the state-wide freeway program.

Second, the need for *improved cooperation* from local communities and governing bodies is apparent. The law requires a freeway agreement between the State and local governing bodies covering the location of freeways through local communities where the street pattern is affected. To the extent that the local governing body takes part in planning the location of a freeway through the local community by

. . . Continued on page 31

Robert E. Reed Chief Counsel of Department

Robert E. Reed, Principal Attorney of the Department of Public Works, was named by Director of Public Works C. H. Purcell to be Chief, Division of Contracts and Rights of Way, to succeed Clifton R. Montgomery who died suddenly on April 19th.

Reed has been in state service since March, 1930, when he went to the Legislative Counsel Bureau in Sacramento from private practice in Oakland. He remained in that position for four years and returned to private practice for a period in connection with the liquidation of northern California banks by the State Superintendent of Banks in 1934. In December of that year, he joined the legal staff of the Department of Public Works. He transferred to the Attorney General's office in June, 1944, as Deputy Attorney General, returning to the Department of Public Works as Principal Attorney in February, 1949.

Born in Piqua, Ohio, August 10, 1905, Reed moved to Coeur d'Alene, Idaho, with his family in 1909. He attended grade and high schools there and then entered the University of Idaho, obtaining a B.S. degree in 1926, following which he entered Stanford University and got a J.D. in law in 1928. He was in private practice in Oakland for a year prior to entering state service.

Reed resides in Sacramento with his wife and three children, Jane, Robert, Jr., and Elizabeth.

In Memoriam

CLIFTON R. MONTGOMERY

THE ENTIRE Department of Public Works was saddened by the sudden death of Mr. Clifton R. Montgomery, Chief Counsel of the Department and Chief of the Division of Contracts and Rights of Way, on the morning of April 19, 1950.

At his death, Mr. Montgomery was only 44 years of age. A native of Lodi, California, he attended Lodi High School, being prominent in athletics, as well as establishing a brilliant scholastic record. He attended Stanford University, graduating with a Bachelor of Arts Degree in 1928, with honors, and obtained the degree of Juris Doctor upon graduation from Stanford Law School in 1930.

During his undergraduate and law school years at Stanford, Mr. Montgomery maintained the scholastic brilliance of which he had shown such great promise in high school, and was rewarded by election to Phi Beta Kappa in his senior year at the University, and to Order of the Coif, the scholastic honor legal fraternity, in his last year at the law school. He was also a member of the social fraternity of Beta Theta Pi and the legal fraternity of Phi Delta Phi.

The great contributions of Clifton Montgomery, known to his many friends as "Monty," to the development of the present and future highway systems of California and the Nation have been known only to his close associates, due primarily to his innate personal modesty. Monty became associated with the department in 1931. His brilliance as a legal scholar, and the fact that he had in him the makings of a sound lawyer quickly came to the attention of his chief, Mr. C. C. Carleton, in connection with drafting of legislation and legal research on highway problems, particularly those having to do with the conception and development of statutory authorization for divided highways and freeways, and the sustaining of the constitutionality of these statutes in the appellate courts.

During the 1930's Mr. Montgomery came to be known and liked by the personnel in all of the district offices as well as at headquarters, for his activities in right of way acquisition, contractors' and damage claim cases took him to all parts of the State on many occasions. As time went on the task of drafting amendments to the Streets and Highways Code, and representing the department in legislative committee hearings, was thrown primarily upon his broad shoulders. That the Collier-Burns Act, which has made possible the department's present freeway program, is on the statute books today, is largely due to the masterful drafting and committee job done by Mr. Montgomery, in the 1947 Legislative Session. So outstanding was his work during this session that district attorneys, city attorneys and legislators throughout the State thereafter came to rely upon his advice and counsel on matters of interpretation of the Collier-Burns Act, and on highway matters generally. Since California is in the forefront in the development of limited access freeways, highway officials and attorneys in other states looked to the California statutes and court decisions, and to Mr. Montgomery personally, for suggestions based on precedents established in this State.

In 1948, when it became known that Mr. Carleton was about to retire as Chief Counsel for the department, it was recognized by everyone in the department that Monty was well qualified as a lawyer and an administrator to step in as head of the Legal Division, which was then undergoing rapid expansion due to increased right of way acquisition activities as a result of the enactment of the Collier-Burns Act. When Mr. Montgomery entered the department in 1931, the Legal Division, aside from several part-time condemnation attorneys having offices in San Francisco, was composed of Mr. Carleton, Frank B. Durkee, now deputy director, and himself. At the time of his death, slightly more than a year after his appointment as chief counsel, there were 22 attorneys in the division, all of whom took great pride in their association and friendship with Monty, and in all of whom he had a close personal interest.

Among the prominent court cases in which Mr. Montgomery participated were those confirming the validity of the financing of the San Francisco-Oakland Bay Bridge by the issuance of revenue bonds.

On March 8th of this year, following preparation of briefs, Mr. Montgomery argued the case of Holloway vs. Purcell, which involved the basic power of the Legislature, the Highway Commission, and the department to relocate and improve highways which were originally financed by the bond issues of 1909, 1915 and 1919. Everyone regrets his untimely passing occurred one week before the Supreme Court wrote an opinion following, not only the contentions, but largely the language of his brief and oral argument.

Mr. Montgomery's death leaves a tremendous void in the department. He was at all times highly regarded, not only by his associates in the department, but by his opponents in court cases and legislative hearings, as an able and vigorous, but eminently fair, advocate of the interests of his client, the State of California.

Everyone who knew Monty, in the department and outside, expresses heartfelt sympathy to his widow, Mrs. Margaret Montgomery, and his daughters, Ann and Elizabeth.

Forest Roads

Californians Use National Parks and Highways in Large Numbers

By J. H. OBERMULLER, Assistant Planning Engineer

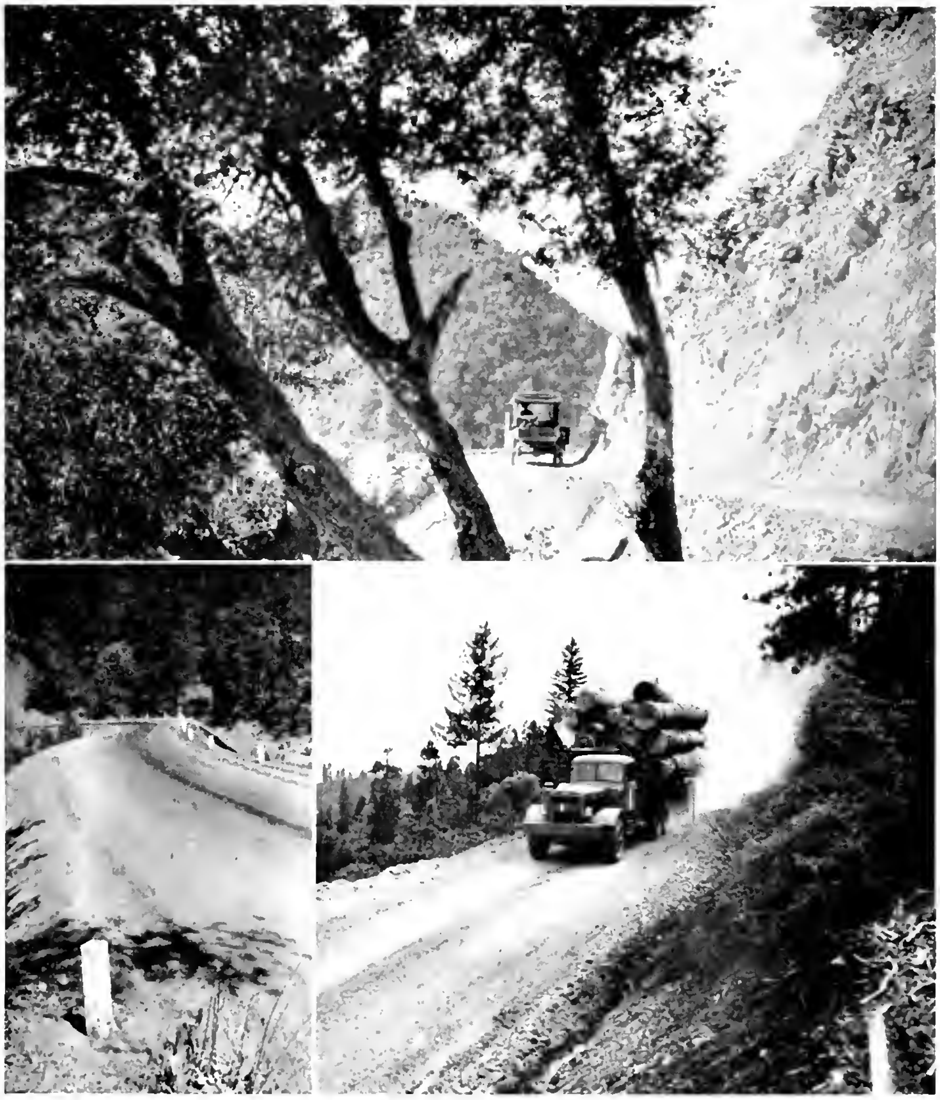
California is justifiably proud of its national forests and national parks. Many of its residents and visitors know our national parks—Yosemite, Sequoia, Lassen—but are not familiar with the extent, the use, the significance of the 18 national forests in this State. The national parks primarily preserve outstanding examples of scenic natural wonders, and their preservation permits only developments required for comfort and convenience of visitors. National forests are for wider utilization.

National forests are selected areas established by Presidential proclamations through reservation of lands in the public domain, supplemented by purchase, donation and exchange. The instruction regarding their administration, issued by the Secretary of Agriculture 45 years ago, still stands: "It must be clearly borne in mind that all land is to be developed to its most productive use for the permanent good of the whole people."

Federal Aid for Forest Highways Initiated

The development of the many uses of these lands depends chiefly on roads and trails to give access to and to traverse the predominantly rugged mountain areas. Then, too, between and within the exterior boundaries of the national forests there are parcels of private holdings and whole communities, all of which require transportation service.

Many roads must pass through the national forests that command the outlying regions of the Sierra Nevadas, the Coast Range and the transverse ridges which separate the State into the heavily populated valleys and coastal plains and the deserts. Small wonder that, in recognition of the nontaxable status of the federal lands and of the peculiar transportation needs within the national forests, the Federal Government should adopt a form of federal aid specifically for forest highways. The formulation of a National Forest Highway System followed.



UPPER—1919 construction on Klamath River awaits reconstruction. LOWER LEFT—Average forest highway standard 10 to 20 years ago. LOWER RIGHT—Width and surface unsuitable when timber production utilizes low or medium classes or forest highway

Federal Aid Funds

The extension of federal aid to the forest highways herein discussed is a supplement to the excellent articles by Mr. C. H. Purcell and Mr. R. F. Reynolds in the November-December, 1949, and the January-February, 1950, issues of *California Highways and Public Works*. They presented comprehensive information on federal aid highway enactments, excepting reference to the forest highways.

The first congressional appropriation for developing roads and trails in the national forests was made in 1912. That was 20 years after President Harrison created the first national forest, "Yellowstone Timber Reserve." California's first apportionment of forest

funds, derived from 10 percent of gross receipts of timber and forage revenues, was $25,000. The 1916 Federal Aid Road Act continued forest road and trail appropriations and was known as "Section 8" provisions. The 1919 Federal Aid Act increased the original $1,000,000 per year for the states as a whole. The aggregate of apportionments to California under these early enactments amounted to about $4,328,000. The money was spent mostly on forest trails and minor forest development roads, and not until 1919 was road work of a more important type started with some of these funds. The Klamath River Highway was initiated in this way.

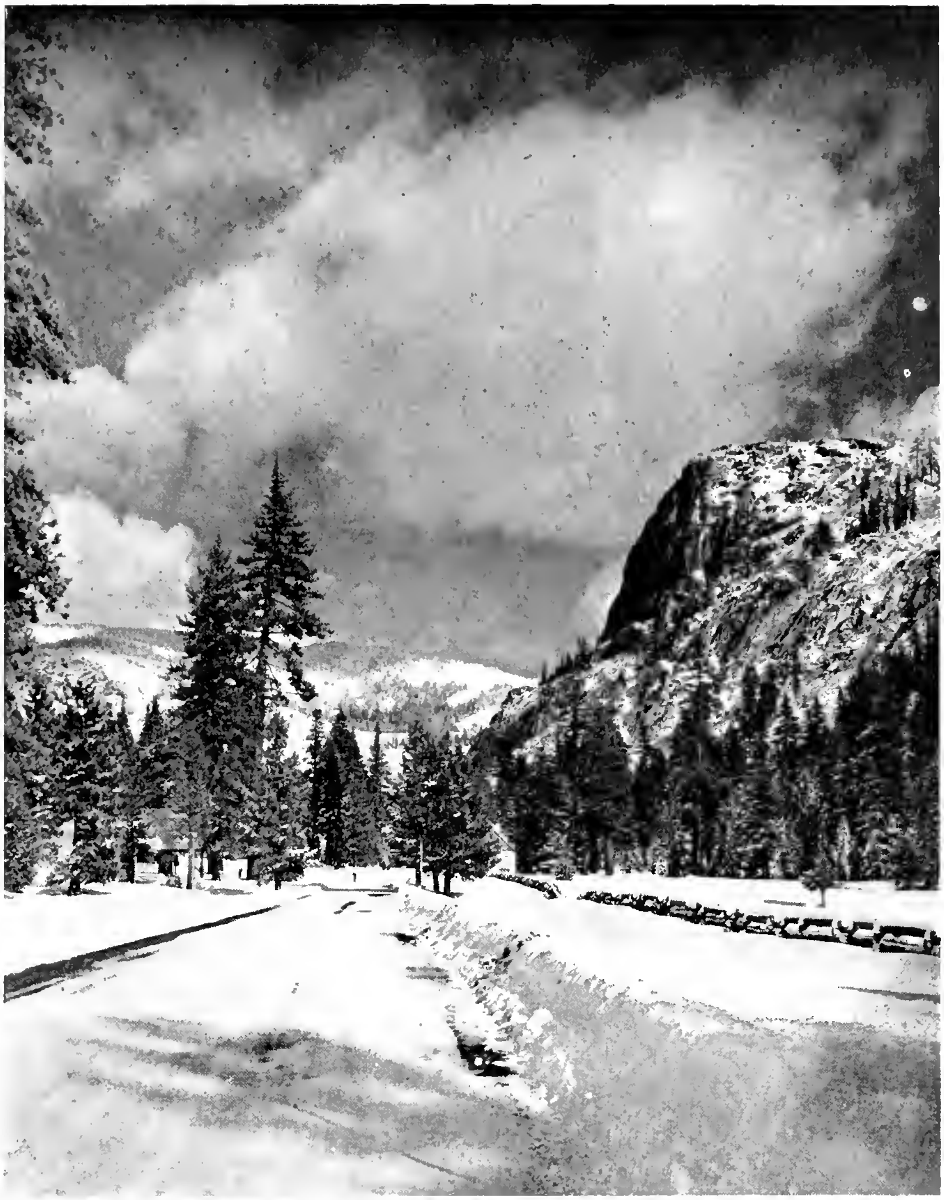
There is a distinction between the national forest highways and the forest development roads, and this distinction appeared with the 1921 Federal Aid Highway Act. Appropriations for development roads and trails within forests are for protection, administration and utilization of the forests. They should not be confused with the funds and the appropriations for forest highways.

Forest Highway System Established

The 1921 act introduced "Section 23" containing reference to forest highways independent of other roads and trails. This necessitated the designation and approval of a National Forest Highway System of "forest roads of primary importance to the counties or communities within, adjoining or adjacent to national forests." Rules and regulations for the administration of and procedure on national forest highways were issued by the Secretary of Agriculture. These rules and regulations, although somewhat revised as forest highway appropriations continued to be included in succeeding federal aid highway acts, remain substantially the same as initially set forth.

First Program in 1921

It is recalled that when the initial list of projects or routes for the National Forest Highway System was adopted and the first program was prepared in 1921, a Forest Service Board including members from Washington, D. C., sat with the California Highway Commission and representatives of the Bureau of Public Roads for these determinations.



On the Placerville-Lake Tahoe Forest Highway

About 70 highways were initially adopted. Subsequent additions to the system have been made jointly by Forestry, Bureau of Public Roads and the State by much the same procedure as is now followed. The State Division of Highways submits a map of eligible roads of primary importance to the Bureau of Public Roads. The latter furnishes copy to Forestry and arranges a joint conference of the three agencies for agreement on recommendation of routes. Routes so agreed upon and recommended by the Regional Forester, the Division Engineer of the Bureau of Public Roads and the State Highway Engineer are forwarded with supporting data to the Commissioner of Public Roads and the Chief of Forest Service for approval.

Additions to or modifications of the system are not made except on important warrants, and then only after reconsideration of the entire system. In general, it is advisable to restrain the system from reaching a size out of proportion to the ability to bring it to adequate condition with revenues that may be expected within a reasonable period.

System Has 2,445 Miles

On June 30, 1949, the system contained 2445.6 miles of forest highways:

Class 1.	On the Federal Aid System	677.8 miles
Class 2.	On the State System, other than Class 1	1233.0 miles
Class 3.	Other forest roads not in Class 1 or Class 2	534.8 miles

Due to the 1933-1935 inclusion in the State Highway System of some 6,800 miles of county roads, 669 miles of roads taken into the Forest Highway System as Class 3 became Class 2 roads and changed the approximate 50-50 ratio of county and state highways theretofore comprising the system.

A list of the forest highways, subject to minor correction, will be found on pages 86-87 of the Third Annual Report of the Division of Highways.

New Classification

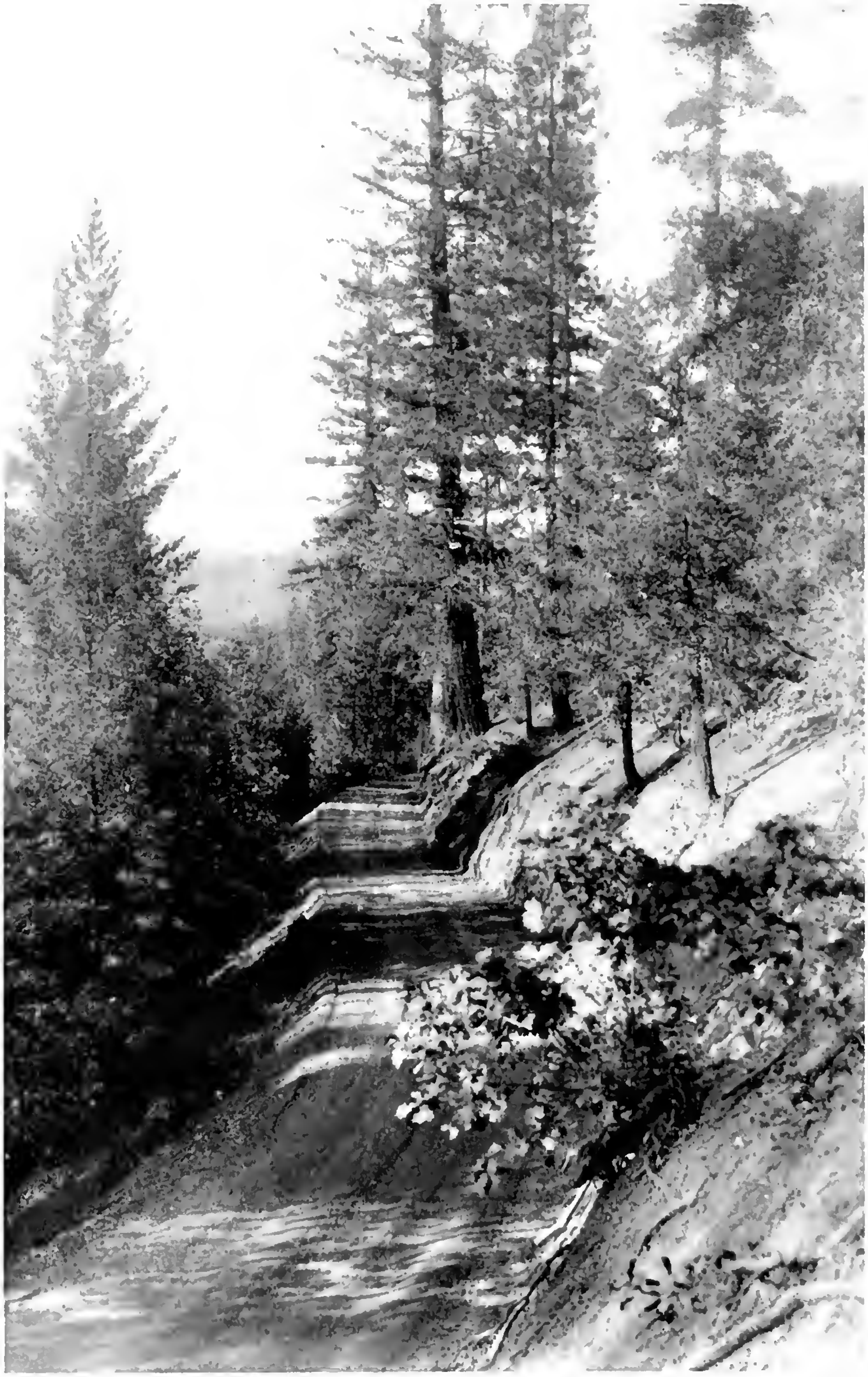
On March 30, 1950, a new classification was authorized to emphasize the federal aid factor so more effective presentation of the Forest Highway System can be made to Congress. The mileage in each of the following new classifications has not yet been worked up.

Class 1. On the Federal Aid Primary System
Class 2. On the Federal Aid Secondary System
Class 3. Other forest highways

Forest Highway Appropriations

The apportionment of forest highway funds to each state is made on the basis of one-half in the ratio that the area of national forest land in any state bears to the total area of such land in all states and one-half in the ratio that the value of national forest land in any state bears to the total value of such land in all states. It is readily understood why states with a small amount of forest land are reluctant to support recommendations to Congress for forest highway appropriations large enough to satisfy the group of western states that contain so much forest area.

Exclusive of the 3,000,000 acres in national parks within national forests boundaries, the 18 national forests in this State contain about 20,000,000 acres. That is about one-ninth of the area of the total 150 U. S. National Forests. It is approximately one-fifth of the area of California. Incidentally it is interesting to note that another two-fifths of California area is classified as woodland, brush and private forests, one-fifth is developed chiefly in agricultural land and the other one-fifth is desert type.



Characteristic of many early forest highway projects providing urgent transportation needs but now outmoded by change in traffic

Apportionments to State

The following tabulates in brief form the amount California was apportioned for national forest highways out of the Federal Aid authorizations to date:

Fiscal Years	Amount
1922-1936	$11,318,760
1937	1,003,403
1938	1,334,121
1939	1,330,615
1940	952,825

Calaveras Big Trees, a major factor in the Ebbetts Pass highway project years ago. The State is reconstructing the road on which lumber hauling sets a new road standard

Fiscal years	Amount
1941	$1,237,745
1942	995,522
1943	994,301
1944	
1945	
1946	3,562,884
1947	3,559,590
1948	
1949	
1950	$2,845,848
1951	2,856,198
Total to date	$31,991,812
Average per year	$1,066,394

Cash appropriations to date have not been as much as the full authorizations in all cases. The deferment of cash appropriations for the postwar authorizations and the cancellation of the ones for 1948 and 1949 have been particularly disappointing. It has the effect of retarding for a still longer period the postwar forest highway program that already had a late start.

Ten percent of the amount apportioned to each state must be placed in a reserve to cover administrative requirement of the Bureau of Public Roads, purchase of equipment, administration by the forest service and in special cases to provide additional funds for programmed projects. Any balance remaining at the end of the year is made available for the forest highway program.

Federal Aid Act of 1948

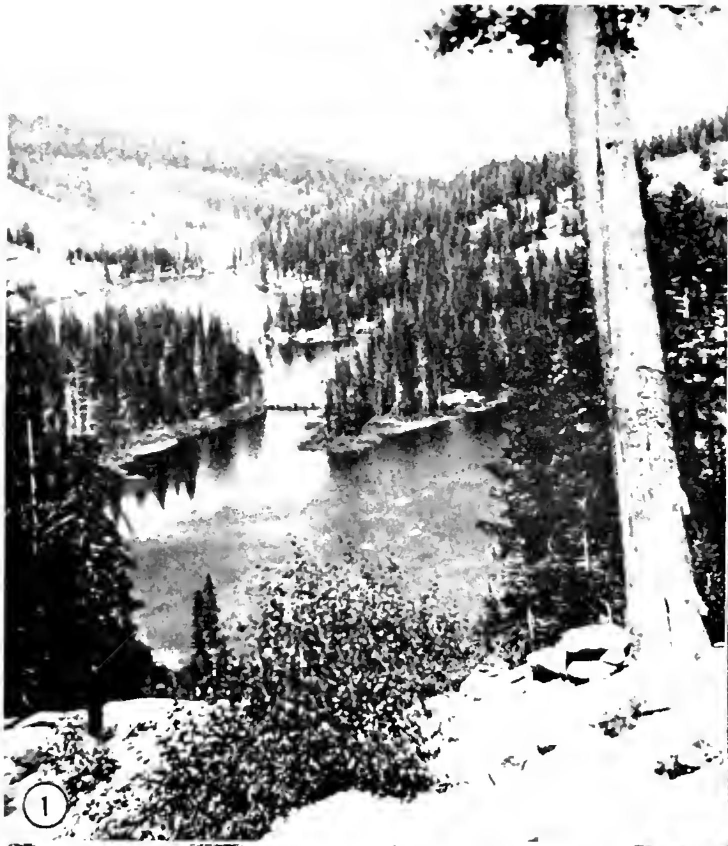
The 1948 Federal Aid Act made an important improvement in the former unreliability of getting appropriations to cover authorizations. It stipulated that appropriations made pursuant to authorizations enacted for forest highways shall be considered available for discharging obligations created by the acts. At the discretion of the Commissioner of Public Roads this facilitates getting programs under way and constructed during favorable seasons. Most of the forest highway projects are within snow areas where the construction season is limited. It had been a serious handicap to withhold advertising until after cash appropriations were released at the end of fiscal years.

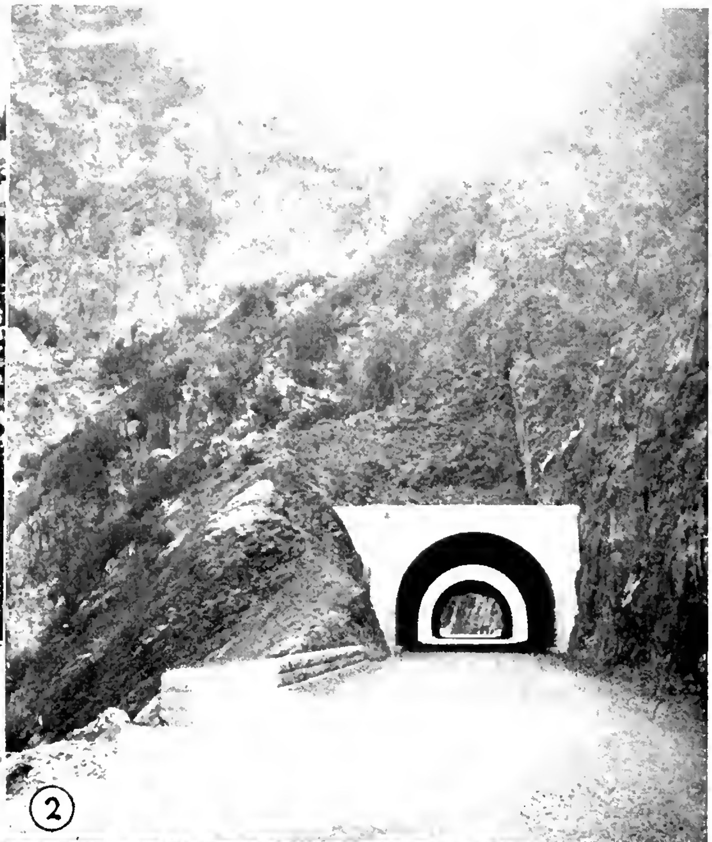
Unless otherwise provided by legislation the annual apportionment to the states is now made by the Secretary of Commerce on or before January 1st of each year.

Forest Highway Programs

Selection of the forest highway program for each apportionment is made by joint agreement of Forestry, Bureau of Public Roads and State Division of Highways in accordance with the following rules:

At request of the bureau the state submits a proposed list of projects supported by a map, together with recommendations on any projects proposed by counties, communities or other agencies. Copies are forwarded to Forestry with further information of the bureau if Forestry desires it. The





1 Twin Lakes from Mammoth Forest Highway. 2 Tunnels improve alignment on Ventura Maricopa Forest Highway. 3 and 4—Representative forest highways designed for moderate traffic

bureau then arranges for a joint conference of the three agencies. Joint report in form of recommended forest highway program is filed with and is subject to the approval of the Commissioner of Public Roads and the Chief of the Forest Service.

Project Requirements

Projects included in these programs must be based upon the following considerations:

(1) Provisions for the maintenance of the forest highways.
(2) The completion of necessary surveys.
(3) Findings of the highway planning survey.
(4) Benefit to forest development, protection and administration.
(5) Requirements for production of timber and mining.
(6) Construction correlation with military requirements and with adjacent federal and state road programs.
(7) The economy of continuity of operations.
(8) Ability of cooperators to maintain adequately the improvement.

Surveys and Plans

Forestry, Bureau of Public Roads and the Division of Highways jointly agree on necessary survey programs by procedure similar to that used in preparing construction programs. A shelf of prepared plans has been kept up well ahead of construction budgets, preceded by reconnaissance studies on any project on which urgencies can be foreseen. The Bureau of Public Roads carries the engineering responsibilities on forest highway projects, although plans prepared by other agencies may be turned over to the bureau for completing contract specifications and contract proposals on forest highway projects. State surveys and plans have thus been utilized in a number of cases.

No construction may be undertaken on a project in a designated forest highway program until survey and estimates are approved by the Bureau of Public Roads and the State Highway Department. Forestry must be given an opportunity to review surveys and plans and to indicate any details of location desirable for the protection or development of the national forests.

Recreational uses of forest highways. UPPER-CENTER—At Pinecrest on Sonora Highway. LOWER—Scene between San Bernardino and Big Bear Lake. Some 10,665,000 vehicles per year use national forests

On the whole, there is very fine correlation of efforts among all three agencies throughout the entire procedure from initiation to completion of the forest highway improvements in California.

Construction

Unless impracticable to construct by contract method forest highway construction must be performed by contract. The Bureau of Public Roads places the advertisement, awards contract and performs the construction engineering on all the projects in forest highway programs.

It should be understood that procedure on forest highway programs for the expenditure of forest highway funds does not limit the work counties and Division of Highways may do on forest highway routes. The whole or parts of routes in the Forest Highway System may be independently located and constructed by the state agencies. When so constructed or reconstructed the projects are not forest highway projects included in the category of federal financed programs discussed herein.

Prominent Routes

Among the more prominent of the 56 routes constructed or under construction with forest highway funds are the following routes:

Routes	Forest
Bear Valley and Mill Creek	San Bernardino
Angeles Crest, Swartout and San Gabriel	Angeles-San Bernardino
Huntington Lake and Oakhurst	Sierra
Maricopa-Ventura	Los Padres
Sonora Pass	Stanislaus
Nevada City-Downieville, Yuba Pass	Tahoe
Placerville-Tahoe	El Dorado
Mt. Shasta-Mt. Lassen	Shasta-Lassen
Quincy-Beckwourth	Plumas
Lava Beds	Modoc
Crescent City (U. S. 199) and Klamath River	Siskiyou, Klamath-6 Rivers
Mosquito Ridge and Douglas City-Peanut (Timber access)	Tahoe and Trinity

Cooperative Financing

Cooperative agreements between the government and the county or State are executed for every forest highway project financed in whole or part by forest highway funds. They contain the detailed provisions agreed upon by each party, including financial contributions from the cooperator, period of federal maintenance and provisions for rights of way and for road materials involving right of way negotiations on private parcels.

Heavy traffic on forest highway through winter sports areas

The government may accept cooperative financing from other agencies. In the early years of forest highway appropriations it was considered highly desirable, although not mandatory, that county or state contribute part of the cost of projects. In some cases up to 50 percent of the cost was so provided as indication of the importance of projects to the cooperator or to insure more construction than might be warranted or possible with available forest highway funds. State contribution to the Big Bear Lake Forest Highway and federal participation in the joint highway project from Ventura to Maricopa are examples of early forest highways jointly financed to facilitate completion of lengthy routes.

Cash Contributions

Whenever cash contributions are made toward construction costs of a project on a forest highway program the funds must be deposited with the Treasurer of the United States in advance of construction. The government does not turn over forest highway funds to county or state, except as reimbursement for construction materials, traffic striping and similar items that may be furnished by the cooperator on a regular forest highway proj-

ect. The regular cooperative agreement or a memorandum of understanding covers these provisions.

Upon completion of construction and after the specified period of federal maintenance, the maintenance of forest highways is the responsibility of the cooperating agency. The federal maintenance generally extends for two years after construction is completed in order to insure the road is stable before it is turned over to the cooperator.

Rights of Way

Rights of way over private lands on forest highway projects are furnished by the agency having the projects in its highway system. A careful distinction is made between construction costs borne by the Government and rights of way costs, the obligation of the cooperator. Unless federal approval of the project program is made well in advance of proposed construction there may be difficulty in getting right of entry for construction without delay.

Forestry's aproval of plans, surveys and estimates for construction on forest highway projects establishes rights of way across forest land parcels. With respect to future jurisdiction of the cooperating agency the right of way is the same as though the latter had applied for and received a special use permit. It is not an easement in the ordinary sense—the areas bordering the road remain under forestry control. Forestry's Regulation L-7 provides one-chain width each side of state highway center line. Actually no limitation is placed on width justifiably required for cut and fill slopes or for other highway appurtenances included in the plans. Any material change in original plans or any revision or relocation subsequent to initial forest highway construction over forest lands is subject to application to forestry for a supplementary special use permit. No encroachment on forest lands is permitted without special use permit.

No Encroachments

Highways across forest lands enjoy a set back regulation under which forestry will not permit encroachments by use of lands within specified distances each side of the highway. On state highways this protection of landscape extends over a strip 200 feet each side of center of the road.

Scenic value and roadside appearance characterize the location and the plans of the forest highways and are predominant factors in the policy of all the agencies. Accepted practices to which each agency is sincerely subscribing include flat slopes rounding and blending into the natural contours of the ground, removal of slash, snags and refuse from bordering forest cover, prevention of avoidable construction scars, permitting no borrow sites that will be visible from the highway, preservation of timber screens and extensive erosion control. Erosion control on all our highways has been developed for maintenance benefits as well as for landscaping values. In the forest areas the stability of cuts and fills is equally important in eliminating silting of adjacent streams, a serious problem in many localities where slopes are steep. Methods of erosion prevention are being covered in a series of articles now running in *Highways and Public Works.*

Problem of Adequate Improvements

In early days of national forest management (the Forest Service was created in 1905) the forest roads served primarily for fire protection. The use and management of the forests, which is Forestry's responsibility, extends to more comprehensive programs for protecting and developing their resources. These resources—recreational opportunities, timber, grazing, water, minerals, fish and game—cannot be utilized advantageously without roads. The forest development roads alone cannot satisfy the requirements. After all, the service to the people is the important issue. The National Forest Highway System was set up, as heretofore stated, to be "roads of primary importance to the counties or communities within, adjoining or adjacent to national forests."

State Contributes Share

The present problem of carrying out forest highway programs that will be well balanced in relation to the respective resources is recognized by Bureau of Public Roads, Forestry and Division of Highways. Adjustments must be made to correlate national policies with local requirements. The determinations must be adaptable to changing needs. The problem is further complicated by the insufficiency of federal appropriations for adequately improving the Forest Highway System.

The California Division of Highways has carried its full burden in financing the Forest Highway System. On the 96 routes and 2,445 miles in that system 1910.8 miles are state highways. The total expenditures on the Forest Highway System to the end of the 1949 Fiscal Year were $112,756,798 according to a recent report of the Bureau of Public Roads. All forest funds account for $25,320,709 of that amount. State, county and other agencies contributed $87,436,089 or about three-fourths of the total expenditures. Of course, the state funds comprised the greater part of the nonfederal cost. On many of the forest highway routes, including many miles of major state highways, no forest highway funds have been expended or can be expected.

Timber Access Roads

Production of lumber has been a predominant consideration in programs for forest highway funds for a number of years, and timber access roads ares still a major item of forest resource development. Meanwhile, the public is demanding better roads through the forests and to recreational areas in the forests. There are 11 trans-Sierra routes through the National Forests of California. There are 1,100 camp grounds in the forests, innumerable picnic areas, 9,500 summer homes on forest leases, many resorts and many developed sites for youth, civic and other organizations.

More and more the rapidly growing population of California is showing tremendous interest in recreational travel and pursuits. Camping, hiking, swimming, boating, hunting, fishing, skiing, or just plain touring induced about 13,000,000 people to travel over federal forest highways last year.

Serve Mutiple Interests

Some of the forest routes serve multiple interests. Some have only seasonal use. Some are developing extensive winter sports use. On many, the peak

Placerville-Lake Tahoe Forest Highway. An example of roadway sections the Bureau of Public Roads is building in rough country as well as in milder terrain

traffic loads exceed comfortable road capacity. Heavy hauling is requiring costly bases and surfaces or causing serious damage and maintenance outlays. Only those roads built on good standard of alignment, width, grade and surface type in heavy snowfall areas can be kept open by heavy snow removal equipment.

It is estimated that the cost of bringing the presently designated Forest Highway System in California to a standard adequate for traffic requirements will be approximately $191,391,000. Apportionments of forest highway funds to California in 1950 and 1951 Fiscal Years have been at the rate of less than $3,000,000 annually for administration, engineering, maintenance and construction. Even with the expenditures the counties and the State are currently able to finance for improving parts of this Forest Highway System, spreading funds thinly over many routes will undoubtedly result in many of the roads becoming obsolete before they can be brought to an adequate or near-adequate standard.

California has been favored with a wealth of magnificent forests and forest resources. It is fortunate in having well qualified, competent and experienced representatives in the U. S. Bureau of Public Roads and in the U. S. Forest Service. It has the appreciation, the sincerity and resolution of the counties and State in the forest highway problem. It cannot do less than hope its people and its Congress will provide.

Road Building Setting All-time High in 1950, ARBA Survey Indicates

ALL HIGHWAY construction dollar volume records are being shattered this year, with $1,446,732,000 in road improvements—exclusive of maintenance—going into place on the systems of the 48 states and the District of Columbia.

A state-by-state survey made by the American Road Builders' Association shows a 15 percent increase this year over 1949's previous record road construction total of $1,262,506,000. In making the figures public, Lt. Gen. Eugene Reybold, ARBA executive vice president, pointed out that maintenance costs—up an estimated $12,761,000 to $452,782,000 from the 1949 expenditure of $440,021,000—will boost the total state highway program for 1950 to $1,899,514,000, as against the previous record high of $1,702,527,000 set in 1949.

Total highway mileage involved in the scheduled 1950 improvements is 46,676, compared with 41,925 miles in 1949. Of the 1950 improvements, 1,718 miles of concrete, 29,977 miles of bituminous mixes and treated types and 14,981 miles of other types of highway (gravel, etc.) are programmed for construction. Expenditures and mileage have no direct relationship, because some more populous states may have to concentrate on construction of more costly expressways, while those with smaller population can build on a smaller scale.

Adieu

District Engineer Fred W. Haselwood, Pioneer Road Builder, Retires From State Service

On May 31, 1950, Fred W. Haselwood, District Engineer for the Division of Highways for the past 24 years, retired.

During 38 years of service with the State, Mr. Haselwood has played an active and responsible part in the expansion of the California Highway System from a few scattered dusty roads to the great network of paved highways which is the proud boast of the State today.

F. W. HASELWOOD 1950

On February 15, 1912, early in the organization period of the California Highway Commission, he accepted an appointment as Principal Assistant Engineer to Division Engineer F. C. Somner, District I at Willits, and became one of 260 employees of the Division of Highways. The early years in District I were pioneering years, as elsewhere in the State, where traffic developed from nothing to a substantial volume even before the Redwood Highway was opened to Oregon. The few hundred employees of the Division of Highways during this period were the real pioneers of our present highway system.

Pioneering Work

In 1923 when R. M. Morton succeeded A. B. Fletcher as State Highway Engineer, he transferred to the newly organized Bridge Department as field investigator and construction engineer.

In August, 1924, he was appointed Division Engineer of District III with headquarters at Sacramento. In spite of 12 years of progress, he found there was still much pioneering left to be done. Oddly enough, the pioneering in District III was largely on the oldest highway in the State, U. S. 50, between Placerville and Lake Tahoe, which in the fifties and sixties was the route between San Francisco and the Comstock Mine in Virginia City, and carried much more traffic then than it did in 1924.

In June, 1929, he was transferred back to District I, the headquarters of which had been moved to Eureka. Times had changed and many of the dusty roads had disappeared, but the increase of traffic was still gaining on highway construction, and there was plenty to be accomplished.

In February, 1932, he was transferred to District II with headquarters at Redding.

Designed Many Highways

In 20 years the highway work and organization had grown tremendously in volume and complexity. Contrasted with the early days when the division engineer did everything, including the acquisition of right of way, work was now divided among assistants, each proficient in his own line, and the more definitely administrative duties were greatly increased. In spite of the increased duties involved in directing the multiple activities of a large district, Mr. Haselwood has found time to devote his personal attention to one of his chief interests, the location and design of new highways. He is responsible for the excellent location and design of hundreds of miles of our modern highways which serve as a monument to his efforts.

Fred Haselwood was born at Milford, Nebraska, in May, 1880, and moved to Kansas 11 years later. After graduating from Kansas State Agricultural College in 1901, he took graduate work in civil engineering with special emphasis on hydraulics at Stanford University until 1903.

F. W. HASELWOOD 1912

Began Career in 1903

He began his active engineering career in 1903 when he went to work for the Western Pacific Railroad. He was a stake artist on a location survey party along the Middle Fork of the Feather River east of Spring Garden Tunnel. Progressing to transitman in a few short months, he located 70 miles of railroad in Nevada. Mr. Haselwood states that E. S. Arnold, the locating engineer in charge, was the highest qualified man employed by the Western Pacific Railroad and was an excellent instructor. The principles of location, learned during this early stage of his career, were to later leave their

Mr. Haselwood on survey of Western Pacific Railroad entering Delaney Canyon on the Middle Fork of the Feather River

mark on many miles of highways in Districts I, II, and III.

In the summer of 1904 he worked for Theodore Hoover at Standard Consolidated Mine at Bodie, California. At this mine mules hauled the cars filled with ore over a level track to the foot of an incline at the stamp mill. Haselwood took over where the mules left off and all he had to do was haul the loaded cars up a 200-foot incline to the upper story of the mill and dump them. Having developed his muscles during this light summer outing, and proving he had the strength of at least one mule, he decided to take up football upon his return to Stanford University. He states that in his first game he inadvertently ran into a brick wall in the form of an opposing Olympic Club player and broke his collarbone. The damage was not permanent and he was back on the playing field after three weeks of idleness.

Varied Experience

Earlier in 1904 he engaged in several odd jobs, among which was one estimating construction costs for the Santa Fe Railroad at Eureka. It was here that he began an association with R. L. "Bob" Thomas, a recently retired fellow highway engineer, that has lasted with frequent contacts for 45 years.

From 1905 to 1909, inclusive, Mr. Haselwood again worked for the Western Pacific Railroad. He ran transit on 225 miles of final location and later was resident engineer on 30 miles of grading and bridges near Altamont and on construction of terminals in Oakland and Stockton.

During 1910 and 1911 he engaged in private practice in San Francisco. In September, 1911, he began work for Nathan Ellery, State Engineer, investigating water rights in Shasta and Tehama Counties.

Upon returning from a trip to Kansas early in 1912 he answered a call from F. G. Sonmer, then Division Engineer of District I at Willits, and began his career with the Division of Highways.

His early experiences during the pioneering days in District I are best told in his own words, and we quote him:

"In 1912 conditions for travel were not very promising in Division I. Mr. Sonmer was furnished a Franklin car and his chief worry was where to use it. With the road conditions that prevailed, it was one jump ahead of walking. There were only two other cars in Willits in those days.

"Early in the history of Division I it became necessary for reconnaissance work and surveys to be undertaken in Humboldt County. The railroad frontier was a short distance north of Willits and the track to Eureka was not constructed until 1914. The short cut to Eureka was by train to San Francisco and thence by boat to Eureka. When Sonmer went to Eureka we usually didn't see anything of him for over a week.

No Soft Job

"Inspection of construction projects was not as rapid as it is today. To get to Contract No. 2 it was necessary to take the train to Hopland and hire a horse and buggy for the rest of the trip.

"In 1915 the first convict camp on the highway system was established at Leggett Valley on the South Fork of the Eel River. There were no roads along the river and the only access to Leggett Valley, other than by trail, was a so-called road from the coast. All supplies for the camp were shipped by boat to Union Landing and hauled over this road by truck in the dry season.

"Inspection trips were hard and tedious. One on which I accompanied Mr. Sonmer required five days. We took the train from Willits to Alder Point, missed the stage and walked to Garberville. The distance may have been less than 30 miles but we tried a short cut, got lost and wandered far out of direction so it seemed a hundred. Three days over rough trail were required to get from Garberville to Cummings.

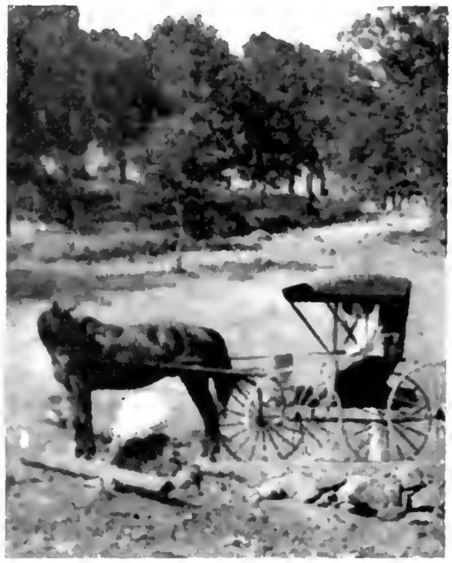
Early Bridge Construction

"Soon a second camp was established and this was a busy area. The major qualification required of a district engineer was resourcefulness and had not Mr. Sonmer possessed this quality to a high degree, the road would never have been built.

"There were several deep, narrow gulches to be crossed and bridges were required. The redwood timber on a 40-acre tract was acquired and a sawmill set up to produce lumber for the bridges. Designs were made in the division office. The most unique of these designs, and my particular pet, was the Rock Creek Arch. Having a span of 150 feet and with the roadbed 150 feet above the stream, this three-hinged timber arch, probably the first

. . . Continued on page 63

Inspection of State Highway Contract No. 2 in Mendocino County in 1912 was made by train, Willits to Hopland, and by horse and buggy from Hopland on



In constructing a highway between Weaverville and Junction City over Oregon Hill in Trinity County, Mr. Haselwood resorted to hydraulicking to level the obstacle. Over 10,000,000 yards of earth were removed in five years by this method

Congestion Relief

Two-lane Section Between Los Angeles and Palm Springs Doomed

By J. M. COWGILL, District Planning Engineer

Construction now in progress on U. S. 70-99 will eliminate the only remaining section of two-lane highway between Los Angeles and the Palm Springs junction, a distance of 90 miles. This improvement will be effected under a contract awarded November 17, 1949, to Fredericksen and Kasler, Sacramento. The contract provides for widening the existing highway to provide a four-lane expressway between 2.3 miles east of Redlands and Beaumont. The length of the project is 9.6 miles.

Figure 1 shows the location of the project in San Bernardino and Riverside counties. The City of Beaumont, at the east end of the construction, is an agricultural center. The orchards and rolling grain fields which surround the city are characteristic of the terrain through which the highway passes.

Part of National System

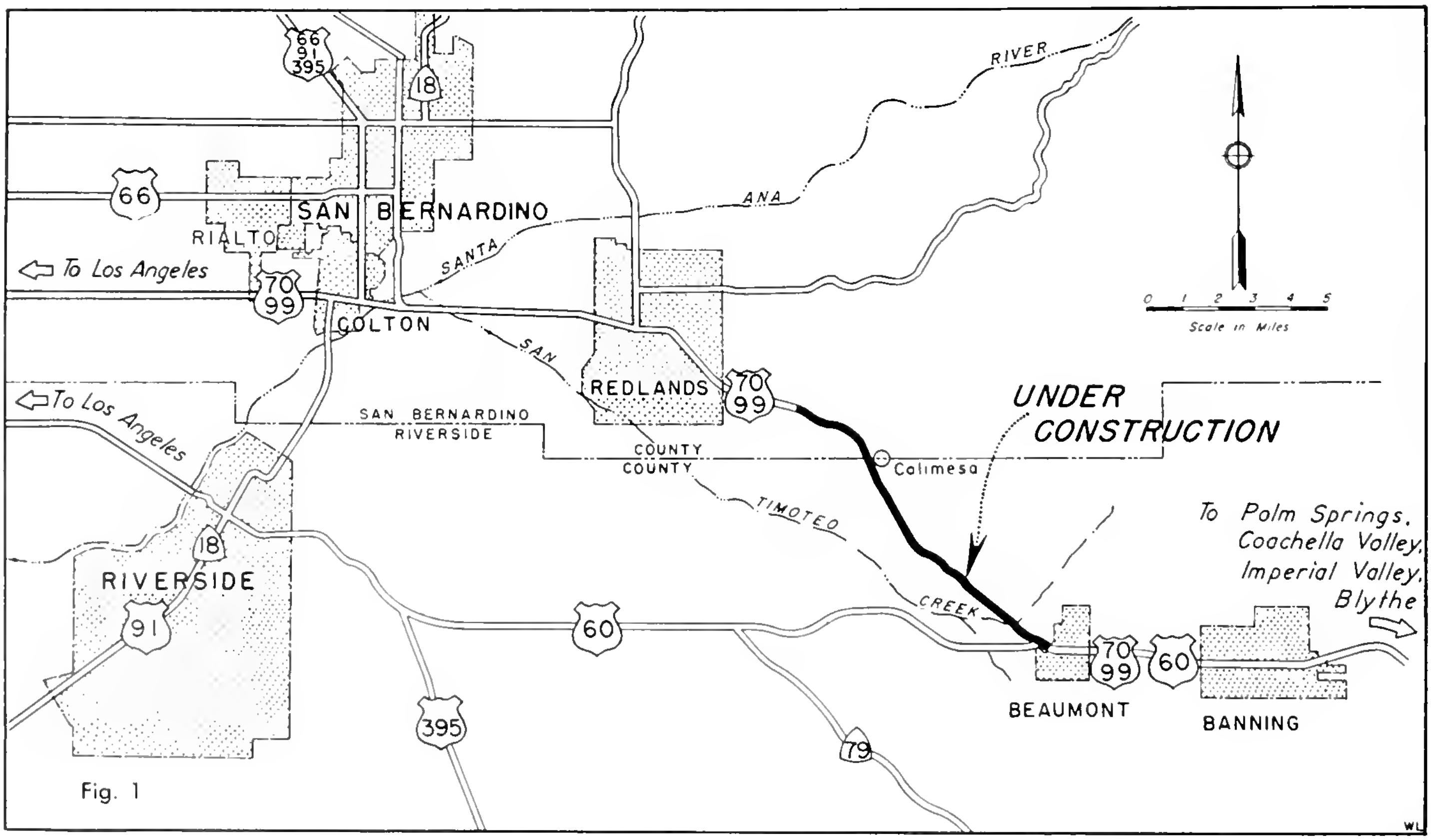
This section of U. S. 70-99 is a part of the National System of Interstate Highways, the limited-mileage basic network of trunk routes established by Congress to connect the nation's principal cities and to serve the national defense.

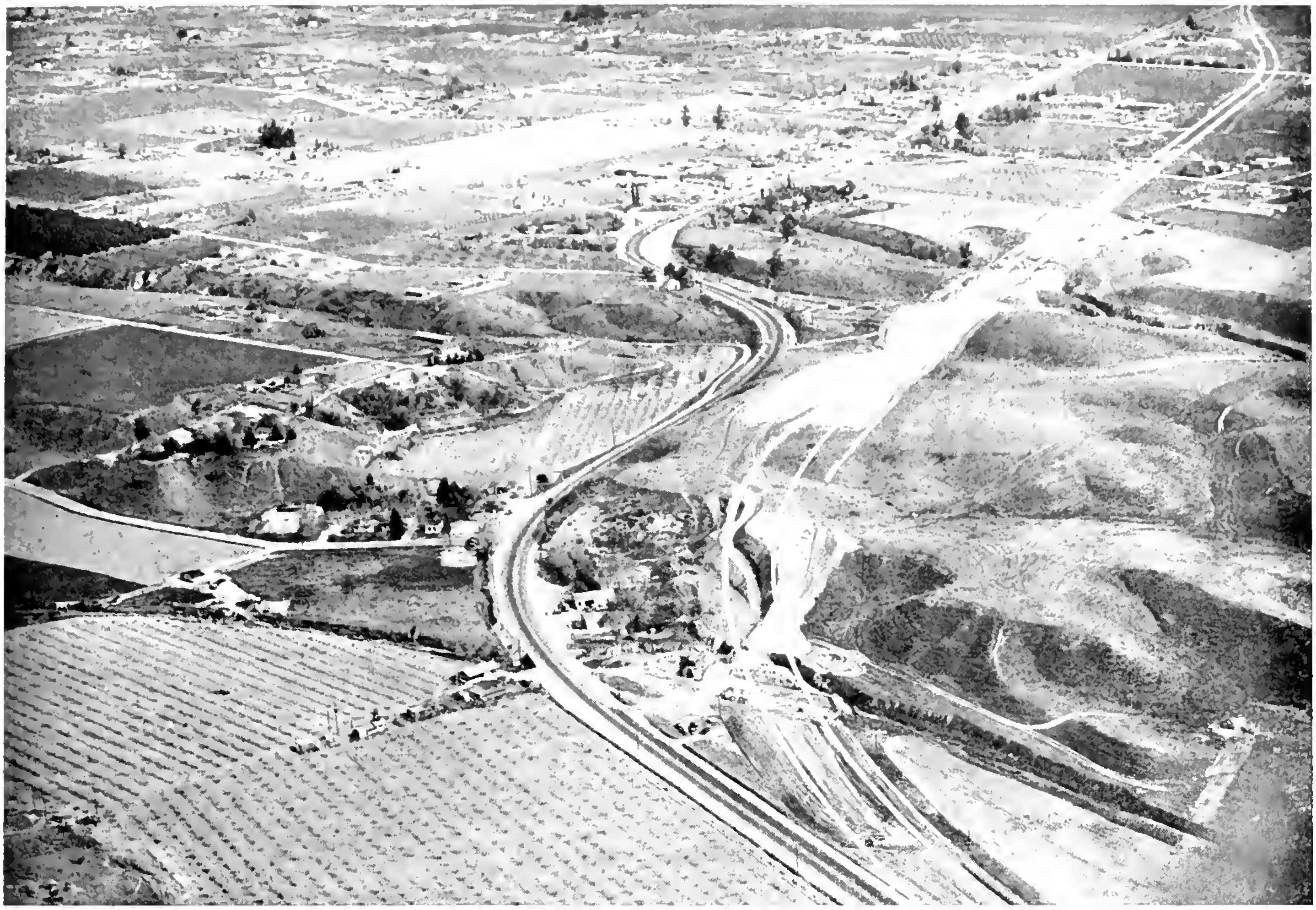
A large proportion of the interstate traffic entering California at its eastern boundary proceeds westerly over this road to the Los Angeles metropolitan area. In addition to the interstate traffic and the local traffic, there are two segments of intrastate traffic that contribute to the high vehicle count. These are the farm-to-market traffic with the Imperial and Coachella Valleys and the recreational traffic with Palm Springs and other desert resort points. The first named traffic is heavy with trucks. Passenger cars are predominant in the Palm Springs traffic. Both of these traffic movements have their other terminus in Los Angeles or neighboring cities to the west of the present project.

Relief of Traffic Congestion

Although this traffic load is shared with U. S. 60 west from Beaumont, the proportion which uses U. S. 70-99 is in excess of the capacity of the existing two-lane highway. Delay and congestion prevail when traffic is held behind slow-moving vehicles which cannot be passed because of the numbers of oncoming cars or because there is not

This map shows the general location of the project between Redlands and Beaumont on U. S. Routes 70-99 and the relationship to other state highways in the area





Aerial view of Calimesa. Business section along existing highway in upper center of photograph will be undisturbed by construction. New location of U. S. 70-99 is indicated at right

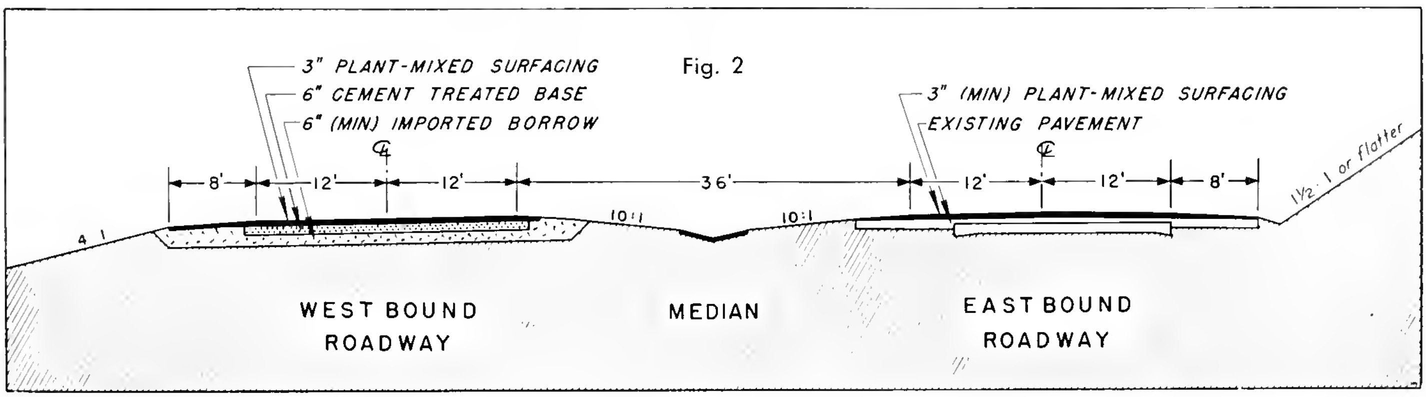
sufficient sight-distance for safe passing. Drivers frequently get impatient under such conditions and accidents follow.

This deficiency will be corrected by constructing an additional two-lane roadway adjacent to the existing roadway, as depicted in the typical cross-section shown in *Figure 2*. The added roadway will be made up of two 12-foot traffic lanes, an 8-foot shoulder on the outside, and a 5-foot shoulder adjacent to the median. The median will provide a width of 36 feet between pavement edges of the separate roadways. This width will constitute a zone of safety to prevent head-on collisions and to relieve headlight glare.

Design of Pavement

The traffic lanes and shoulder will be surfaced with plant-mixed surfacing, three inches thick. The plant-mixed surfacing of the traffic lanes will

Typical cross-section of the highway. Where the roadways are on different levels, steeper cross slopes (up to 2:1) will be used in the median and guard railing will be constructed



Grading operations in progress three miles northwest of Beaumont. Existing pavement at right will be resurfaced and will form southbound lanes of expressway

be placed upon a cement treated base, six inches thick. The base consists of mineral aggregate which is mixed with Portland cement and water at a central mixing plant.

Tests have determined that the bearing capacity of the local soil is inadequate to directly support the base, so the plans call for a subbase of imported borrow, which will be excavated by the contractor from sources outside the highway right of way. The imported borrow subbase will be placed in thicknesses varying from six inches to 15 inches, depending on the bearing capacity of the local soil.

The pavement of the existing two-lane roadway will be reinforced by resurfacing with plant-mixed surfacing. This will also have the desirable effect of giving uniformity of appearance to the two roadways.

A seal coat of asphaltic emulsion will be applied to the completed surfacing. On the traffic lanes the seal coat will be covered with fine screenings (¼-inch x No. 10).

Erosion Control

To provide erosion control and a better appearance of the roadsides, slopes are being seeded with a mixture of barley, rye grass and alfalfa seed. The work calls for cultivation of the cut slopes and incorporation of straw to provide protection during germination and until the growth of grasses becomes established. The slopes that were first completed are now displaying a fine stand of grass.

At Calimesa, a community of small farms, the present highway passes through the business section. There is a resulting mutual hindrance between through traffic and patrons of the business district. To eliminate this conflict and accomplish the highway widening without disturbing the business buildings, the expressway is being constructed on a location which skirts the west side of Calimesa. This realignment, which is indicated on the accompanying photograph, also provides a saving in distance and eliminates from

Just west of Beaumont U. S. 70-99 joins U. S. 60. This sketch shows the layout of connecting roadways that will be constructed to provide interchange between the two highways. The separation structure will permit free flow of opposing streams of traffic

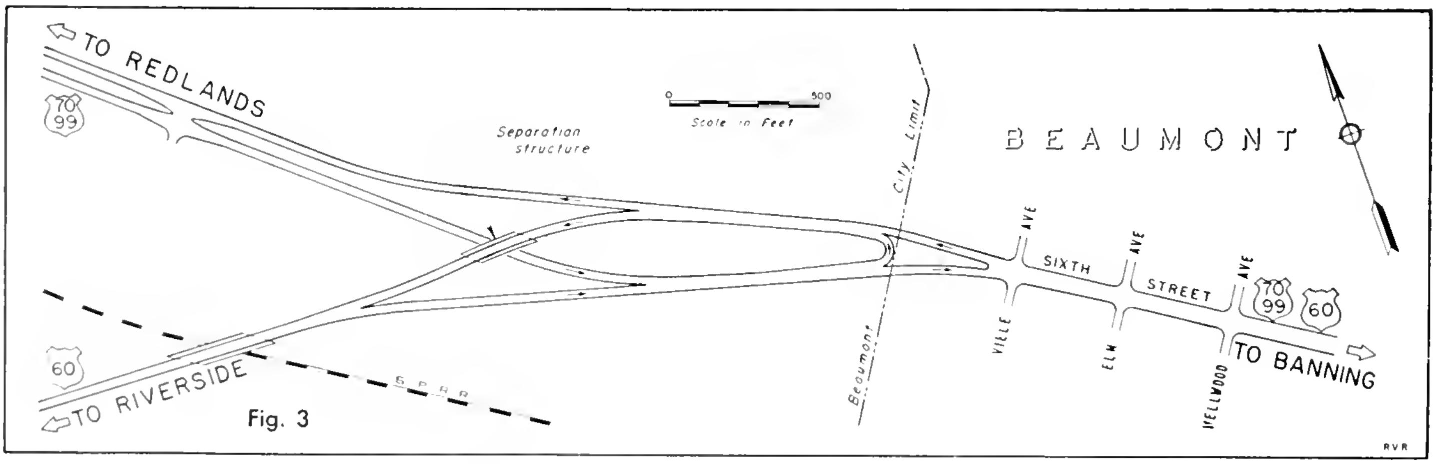


Fig. 3

the path of through traffic a sequence of curves whose lack of sight distance has been the cause of annoying delay and hazard.

Intersection Problem

The junction with U. S. 60, one-fourth mile west of Beamont, posed a major intersection problem. To provide for the uninterrupted flow of the crossing and merging streams of traffic, the project plans call for the construction of a separation structure and a system of roadways on high standards of curvature. The essential features are sketched in *Figure 3*.

All the roadways provide a width for two lanes of traffic. The separation bridge will have a width of 28 feet between curbs to carry the westbound roadway of U. S. 60 across the eastbound roadway of U. S. 70-99. It will be a reinforced concrete box girder type of bridge, consisting of a main span 72 feet long, two side spans each 49 feet long and two cantilever spans each 4 feet 6 inches long. The bridge will be supported on reinforced concrete bents and abutments on timber treated piles.

The middle fork of San Timoteo Creek will be crossed by a reinforced concrete slab type of bridge consisting of three spans each 22 feet long and two spans each 18 feet long, supported on concrete pile bents and reinforced concrete abutments on concrete piles. The bridge will provide a width of 28 feet between curbs to carry the westbound roadway of U. S. 70-99.

Thirteen Culverts

In addition to the two bridges, the project includes thirteen reinforced concrete box culverts to be constructed or extended. The culvert work has been completed by the contractor. The major items of work involved in the bridge and culvert construction include approximately 11,700 cubic yards structure excavation and backfill, 3,100 cubic yards Class "A" Portland cement concrete, and 475,000 pounds bar reinforcing steel.

Roadway excavation and related grading operations have been substantially completed by the contractor. This work has included approximately 630,000 cubic yards of roadway excavation and 9,900,000 station yards overhaul. Major equipment employed by the contractor on the grading work has included 12 D-8 tractors, six carrying scrapers of 14-22 cubic yard capacity, four double units of 60-inch diameter sheepsfoot rollers, two heavy duty motor graders, a 1¾ cubic yard power shovel, and six 10-wheel dump trucks. The imported borrow subbase, which is expected to total 130,000 cubic yards, is now being excavated and placed.

PHONE CABLE IS PROTECTED DURING ROAD CONSTRUCTION

Among the utility facilities which occupy the highway right of way on U. S. 70-99 between Redlands and Beaumont is a coaxial cable of the Pacific Telephone and Telegraph Company. An interesting preliminary to the highway construction was the work performed by the company in connection with the cable.

In order to protect this costly and vital facility from possible damage by construction operations, the company constructed a concrete slab over the cable at all places where the cable was not deeper than five feet below the roadway grade. At locations where existing manholes were within the proposed traveled way, the manholes were closed and an access tunnel leading to the manhole from the side of the roadway was constructed. Construction of these access tunnels reflects the desire of the Pacific Telephone and Telegraph Company to cooperate in the movement for public safety. Elimination of manholes from the pavement area will make it unnecessary for the company employees to open manholes or do any work on the highway pavement. Thus, elimination of hazard for both motorists and company personnel is accomplished.

Paving Plants Established

The contractor has established his paving plants on Singleton Road at a point about one mile east of the center of the project, where he has determined that deposits of suitable mineral aggregate are available. Separate mixing plants have been erected for cement treated base and for plant-mixed surfacing with batch capacities of 6,000 pounds and 4,000 pounds respectively.

The base and surfacing for the project will require approximate quantities as follows:

65,000 tons mineral aggregate for cement treated base
67,000 tons mineral aggregate for plant-mixed surfacing
17,500 barrels Portland cement
3,350 tons paving asphalt

The estimated total cost of contract items is $1,143,000. The contract provides for the completion of the work in June, 1951. Mr. C. E. Kasler, partner in Fredericksen and Kasler, who is supervising the firm's work, has said that he is scheduling his operations to accomplish completion of the construction well in advance of the required time.

Control of Access

The completed highway's status as an expressway will derive not only from the advanced design of the facility, but also from the control of access. Through negotiation with owners of abutting property, ingress and egress to the roadway has been permanently limited to a minimum number of specific openings. The access openings have been located at points where the safest possible conditions may be obtained for vehicles entering and leaving the highway. In order to avoid the hazards of private driveways entering into the roadways of the intersection with U. S. 60, frontage roads will be constructed to provide service to the properties which front on the intersection.

The service of the expressway will be made available to the surrounding area by means of connections to county highways.

Thirteen Intersections

There will be thirteen intersections in the 9.6 miles length of the project. The two intersections which provide entrance to Calimesa and the intersection at Woodland Avenue are expected to handle the largest volumes of traffic from the local area. This traffic requirement has been recognized by providing channelization of the intersections. The scheme for connecting county highways to the expressway

. . . Continued on page 26

NEW UNIT OF BAYSHORE FREEWAY

Aerial photo of Bayshore Freeway project under construction and centerline projection through adjacent area. Solid line area now under contract; broken line area future location

The much discussed Metropolitan System of Freeways in San Francisco is now under way; the first unit covers a distance of one and a third miles between Augusta Street on the south where it conforms with the Bayshore Boulevard and terminates at Twenty-fifth Street on the north about three blocks east of Potrero Avenue. Both of these termini points make temporary connections to the existing highway.

The contract for this first unit was awarded to Guy F. Atkinson Company and Charles L. Harney, Inc., of South San Francisco and San Francisco, respectively, as a joint venture for $2,819,378.90 on May 11, 1949. The right of way cost of this section was approximately $3,000,000, making a total cost of about $6,000,000 for one and a third miles. The project is financed from state gas tax, federal aid and the San Francisco City and County apportionment of gas tax funds.

In planning this job, much study was made relative to the serious traffic problems, the number of going business establishments that would be affected by construction and the surface and underground utility obstructions. The work of removing factories and other buildings began more than two years before the advertisement of the contract and many of the utilities were relocated during this period.

The average week day automobile and truck traffic on this section of the Bayshore Boulevard is approximately 60,000 vehicles per day.

The traffic situation was made much more difficult by the bridge construction by the City of San Francisco at Islais Creek and Third Street, which closed one of the other main arteries for through traffic between San Francisco and the peninsula area, thereby greatly increasing the amount of traffic which had to be handled through construction.

Two Major Interchanges

There are two major interchanges included in the contract; one at the intersection of Alemany Boulevard and the Bayshore Highway and the other at the junction of Army Street and the Bayshore Highway. When this project is completed, the main line traffic will be carried above both of these intersections, with local city street traffic passing underneath. The main freeway will be an eight-lane divided highway. Alemany Boulevard is located on an area that at one time was part of the meandering Islais Creek and, as industries became established in this area, more and more of the delta land was filled up with refuse and at a later date a shallow crust of poor fill material was placed. It was necessary to remove large quantities of this unsatisfactory material prior to beginning construction of the various roadways for the planned rotary and piling to support the structures were driven to depths up to 100 feet. The rotary approach roadways will be paved with plant-mixed material on a cement treated base. The main line of the freeway will be paved with Portland cement concrete on a cement treated subgrade.

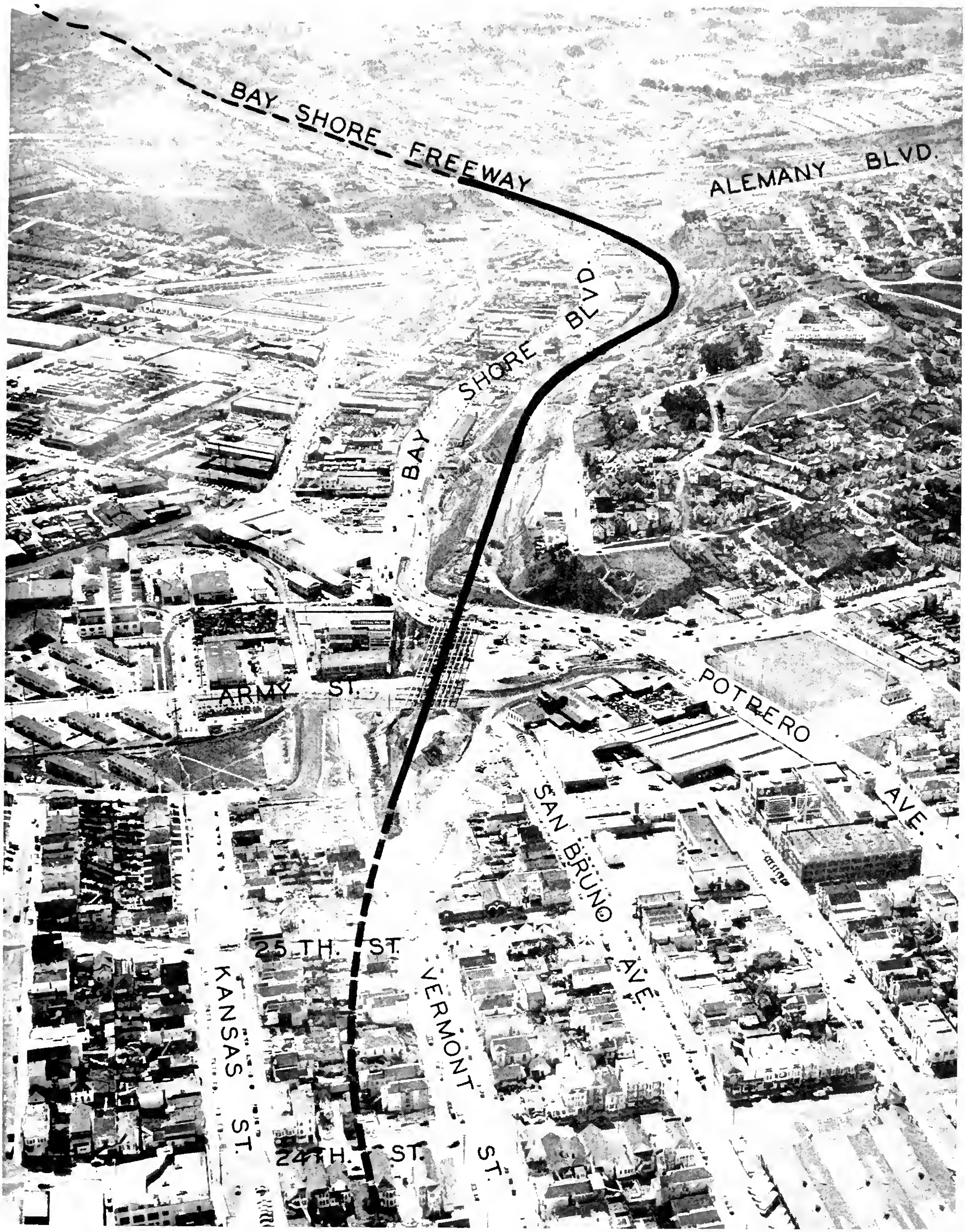
This contract is expected to be completed by the latter part of December, 1950. This work is all under the direction of Jno. H. Skeggs, Assistant State Highway Engineer, with headquarters in San Francisco. H. A. Simard is the Resident Engineer, and G. W. Thompson the Bridge Department representative.

Heavy grading operations on Redlands-Beaumont highway project

was worked out with the Counties of Riverside and San Bernardino and embodied in an agreement with the Riverside County Board of Supervisors, signed by Chairman Floyd E. Gilmore, and an agreement with the San Bernardino County Board of Supervisors, signed by Chairman Frank H. Mogle.

This highway is on the U. S. Federal Aid System and the current construction will be financed in part by federal aid. Mr. F. C. Brown, District Engineer of the Bureau of Public Roads, administers federal aid in California.

For the Division of Highways, E. A. Bannister is Resident Engineer and F. M. Morrill is Bridge Department Representative on the project.


BAY SHORE FREEWAY
ALEMANY BLVD.
BAY SHORE BLVD.
ARMY ST.
POTRERO AVE.
SAN BRUNO AVE.
25 TH. ST.
KANSAS ST.
VERMONT ST.
24TH. ST.

San Fernando

New Highway Construction in Southern City Is Under Way

By F. E. STURGEON, Resident Engineer

A SERIOUS traffic situation will be eliminated upon completion of a Division of Highways construction program through the City of San Fernando in Los Angeles County. U. S. Highway 99, the State's most important north-south artery, is the principal business street through the city. This street, known as San Fernando Road, is paved 56 feet wide between curbs, with abutting property presenting a solid frontage of business houses. Local business and the very heavy through traffic along with curb side parking and the usual cross street pedestrian movement in this shopping and business area cause a great deal of confusion, interference and delay to local traffic and loss of time to through traffic.

Unusual Divided Highway

To alleviate the congestion and confusion on San Fernando Road, the Division of Highways now has a contract under way on State Highway Route 213 for the construction of 1.6 miles of 64-foot width roadway through the City of San Fernando. This new roadway will parallel San Fernando Road on the northeasterly side and bypass the business area.

Upon completion the new highway and existing San Fernando Road will essentially be a divided highway with a block of business houses occupying the area between. The new construction will provide a one-way roadway for northbound traffic, while existing San Fernando Road will be converted to a one-way roadway for southbound traffic. Traffic islands at the junction of the roads at both ends will facilitate safe handling of moving traffic. The new highway will not be classed as a freeway and business houses may be established on it, while business houses fronting on existing San Fernando Road may open entrances on the new road through the rear of their existing buildings.

Typical Section

The improvement consists of placing an asphalt concrete pavement 60 feet wide and 6 inches thick on an 8-inch cement treated base. Outer curb and 2-foot gutter will provide an overall width of 64 feet between curbs. Drainage will be handled by the installation and construction of various concrete pipe storm drains, catch basins and reinforced concrete boxes. Flasher and signal installations are being installed under separate contract.

Due to low relative compaction of the original ground, the roadway was excavated to a depth of two feet below profile grade and the exposed surface rolled to secure a minimum 90 percent relative compaction in the upper 6 inches of the material being compacted. The trench was then backfilled with material previously excavated and recompacted to a minimum 90 percent relative compaction. A few small details involved in bringing the roadbed to grade consisted of installing sanitary sewer house connections and filling existing cesspools, removing approximately 4,000 cubic yards of unsuitable materials, and breaking up and removing massive reinforced concrete machinery foundations. The founda-

Congested traffic conditions on existing San Fernando Road at Macloy Avenue to be relieved when new construction is completed. This street will be for one-way southbound traffic and the new construction will be for northbound traffic

Shaping roadbed on Route 213 through the industrial area of the City of San Fernando

tions were cracked with hydraulic jacks operating in holes previously drilled by jack hammers, then broken up with a D-8 dozer.

Artesian Wells Uncovered

Exploratory work to determine the cause of a seepage area at the north end of the job resulted in uncovering two flowing artesian wells located a few feet off center line of construction. These wells formerly were a source of water supply for the Southern Pacific Railroad. They were abandoned some years ago and the area in which they were located, being a small draw, was used as a disposal area for miscellaneous debris, combustible material and broken concrete. As the years went by the dump increased in height over the wells and the water found its way underground to a nearby stream bed. After removing the unsuitable material the well casings were exposed. Rather than plug them, with the possibility that they might break out at some unexpected place, the casings were cut off at a depth of 8 feet below profile grade and the water conducted through drain tile in a filter material filled ditch to a newly constructed double 7-foot x 8-foot reinforced concrete box culvert.

The only large drainage structure involved in the contract is the double box culvert referred to above. It carries storm water across the right of way by extending an existing double 7-foot x 8-foot reinforced concrete box culvert under San Fernando Road on the west to join the wing walls of a small railroad bridge on the east.

Status of Construction Contract

At this writing the earthwork has been completed, curbs and gutters are 90 percent complete, concrete pipe storm drains and drainage structures are 75 percent complete. Cement treated base was started last month. Vido Kovacevich Company is the contractor and R. A. Engle is the superintendent for the contractor.

The contract allotment is $251,300, and by the time this is published construction work will be better than 50 percent complete. The estimated date of completion is September 1, 1950.

Construction operations near northerly end of contract showing form construction for double 7-inch by 8-inch reinforced concrete box culvert

Santa Ana Freeway

Another Major Unit Is Opened to Public Travel

By J. W. GREEN, Southern Representative, Bridge Department

On April twelfth another major unit of the Santa Ana Freeway was opened to public traffic. Without ceremony or formalities the barricades were removed and the public was permitted to move over this completed section of the Santa Ana Freeway between La Verne Avenue and Eastland Avenue, a distance of one mile. While the actual distance is relatively short, the fact that this completed construction separates the Atlantic Boulevard heavy traffic from the Anaheim-Telegraph Road heavy traffic has alleviated a bad traffic bottleneck for those motorists who regularly use either one of these two important state highways.

The Santa Ana Freeway, when completed, will become one of the most important connections of the Los Angeles area with Orange and San Diego Counties. This is one of the major freeways that have been established to serve Southern California areas. It extends from the Los Angeles Civic Center in a general southeasterly direction through Los Angeles County and Orange County to the City of Santa Ana.

Outer Highways

The work done under this recently completed contract consisted, in general, of constructing one mile of freeway, with outer highways, intersecting and connecting roadways, placing Portland cement concrete pavement on a cement treated subgrade and plant-mixed surfacing on untreated rock base, a railroad underpass, two highway grade separations, a pumphouse, storm drains, sanitary sewers, and other necessary work.

The freeway construction consisted of grading and paving three 12-foot lanes for traffic in each direction, separated by a 12-foot median strip. Portland cement concrete pavement, eight inches thick, was used for the surfacing of the freeway, Atlantic Boulevard and Industrial Avenue. Imported subgrade material, 1.83 feet in thickness, was placed under the pavement and the upper four inches of which was cement treated.

The Atlantic Boulevard Overcrossing structure is a reinforced concrete bridge of continuous box-girder construction, including reinforced concrete abutments and a four-column center bent, all with spread footings. The bridge consists of two spans, one 62 feet and one 68 feet, designed for six 12-foot traffic lanes and a 6-foot dividing strip, two 5-foot sidewalks, and steel handrails.

Grade Separations

The Goodrich Avenue Overcrossing is a reinforced concrete bridge similar in design to the Atlantic Boulevard separation except the roadway is 26 feet wide, with one 6-foot sidewalk. It is constructed on a 351-foot radius curve, with standard retaining walls to support the approach fills.

The East Los Angeles Station railroad grade separation is a two-span plate girder bridge, designed with a E-75 railroad loading to carry three tracks of the Union Pacific Railroad. Each span has fifteen 71-foot-6-inch x 7-foot-1 1/2-inch plate girders at 3-foot-2 3/16-inch center to center. Girders are supported on reinforced concrete abutments and center pier, all on spread footings. Track and ballast are carried on a 7-inch concrete deck,

Looking northwesterly showing Atlantic Boulevard Bridge in foreground, with Union Pacific Railroad grade separation in background

View looking northeasterly, showing completed Santa Ana Freeway, taken just before opening to public traffic, with Goodrich Avenue Bridge in foreground

49 feet-9 inches wide. Approach fills are retained by specially designed cantilever retaining walls.

In addition to the customary reflectorized warning and directional signals, large special signs were installed at the turn-off locations. These signs are placed high above the driver's eye so as to be visible from a considerable distance. For ease in reading these directional signs at night, a special type of fluorescent lighting has been provided. At all on and off interchange roadway connections, adequate safety lighting has been provided. The sreel lighting standards place the luminaires 30 feet above the pavement.

At the intersections of Atlantic Boulevard with Industrial Avenue, Anaheim-Telegraph Road and Goodrich Avenue, systems of fully actuated traffic signals were installed.

Construction operations on this contract were described in a previous joint article by Resident Engineers G. L. Laird and B. N. Frykland in the May-June 1949 issue of the *California Highways and Public Works* magazine.

Bridge construction was under the general supervision of F. W. Panhorst, Assistant State Highway Engineer, and the highway work under the supervision of P. O. Harding, Assistant State Highway Engineer in charge of District VII. The contract was administered by the Bridge Department of the Division of Highways. The Griffith Company of Los Angeles was the contractor. The total value of the contract work for this unit of the freeway was $1,383,908.96.

FLUORESCENT HIGHWAY INTERSECTION LIGHTING

By F. M. CARTER, Senior Highway Engineer, and
ROY W. MATTHEWS, Associate Electrical Engineer

RURAL INTERSECTION LIGHTING has always been a problem to illuminating engineers because the ordinary street lighting luminaires, which are not objectionable in cities where there is an abundance of other lights, become an annoying glare source against the black sky background at rural intersections on our high speed highways.

The addition of glare shields to present-day street lighting luminaires has been of much benefir, but with the conventional light sources the discomfort has not been entirely removed.

For many years it has been thought that fluorescent lamps should be used in highway lighting, but the ordinary fluorescent lamps had several disadvantages which made their use impractical for street or highway lighting.

Fluorescent Lamp Development

In recent years, however, there has been considerable activity in the development of fluorescent lamps.

One recent development has been the introduction of the slimline types of fluorescent lamps which are now available in a variety of sizes and colors. These lamps are insrant starting (require no starter as do ordinary fluorescent lamps), and have a high light output as well as an extremely long life.

The California Division of Highways has been using these lamps to illuminate overhead signs on the freeways for a year or more, and the results have been very satisfactory.

One of the latest lamps announced is 1½ inches in diameter, eight feet long, and can produce a light outpur of 5,800 lumens at an operating current of 600 milliamperes. Four of these lamps when placed in one luminaire would produce a total of 23,200 lumen, or slightly more than the amount produced by one 21,000 lumen mercury

. . . Continued on page 50

Erosion Control

Methods Used on California State Highways Discussed

By H. DANA BOWERS, Supervising Landscape Architect

California, a wrinkled ribbon of land more than 800 miles long lying between the high Sierras and the Pacific Ocean, stretches from the humid forested zone characteristic of the Pacific Northwest to arid northern Mexico, and ranges in elevation from below sea level to more than 14,000 feet. Climatic variations are extreme, as might be expected, and erosion control problems vary correspondingly. Many different types of control have, therefore, been found to be necessary.

The purpose of this series of articles is to discuss the variable factors associated with erosion which affect California roadsides, review the development of erosion control methods by the State Division of Highways, and describe erosion control processes now being employed with reasonable success to stabilize slopes on California state highways. This is the fourth installment.

It is felt that at least a few of the methods which have proved effective in California may be modified to suit conditions in other regions. Consequently, descriptions have been made as complete and are illustrated as fully as possible in order to permit duplication of these methods by nontechnical personnel.

The erosion problem on agricultural lands is another matter entirely. Since this phase of the subject is adequately treated in publications of the Soil Conservation Service we will consider here only erosion as it directly affects roadsides.

STABILIZATION

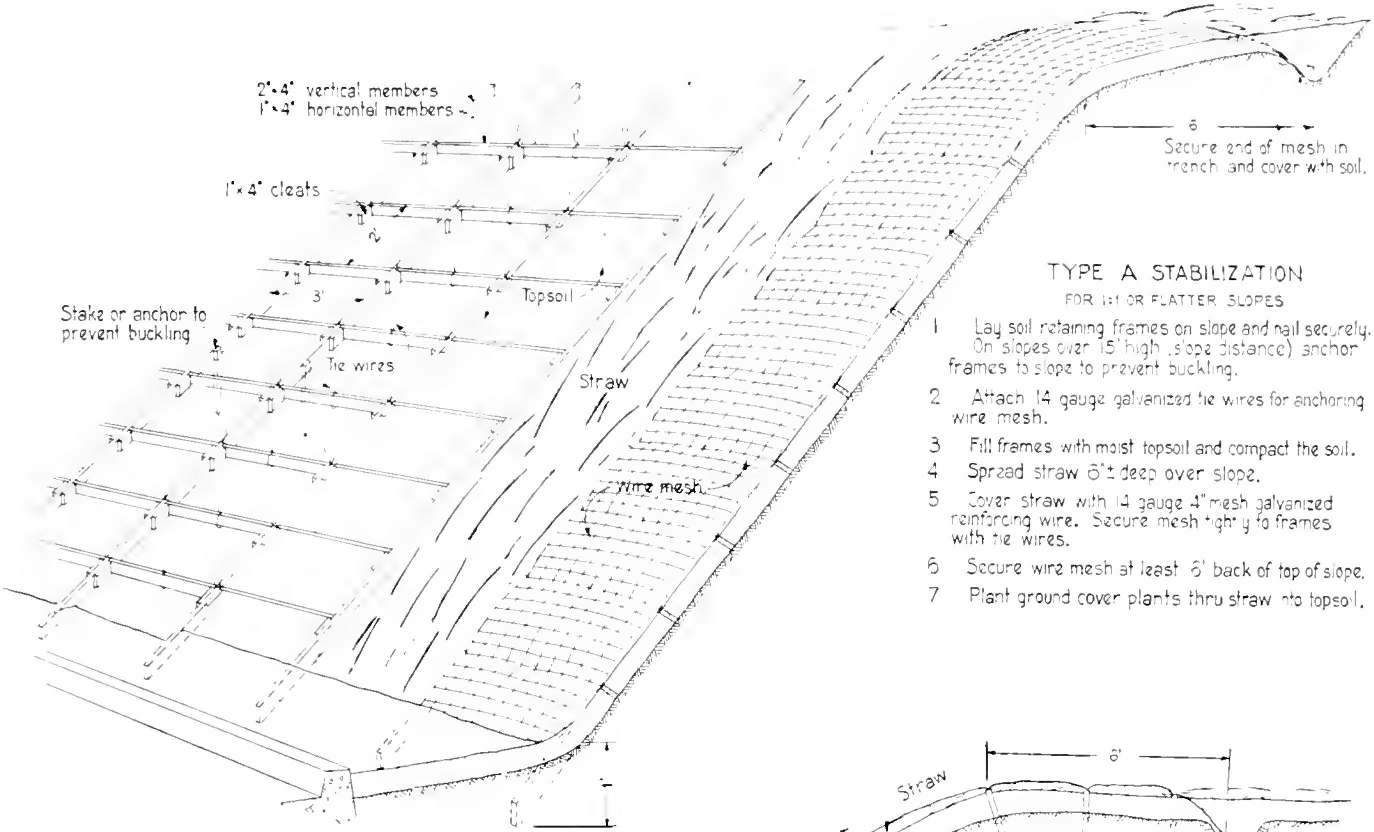
An elaborate method for stabilizing steep slopes was developed to suit special conditions sometimes found on our metropolitan freeways. (*See Slope Stabilization Detail Sheet.*) In highly developed urban areas the cost of purchasing a wider right of way to allow for the construction of flatter slopes may be excessive. In this event, the expense involved in installing this type of stabilization treatment, though high, is justified in that a considerable net saving in expenditure of highway funds is possible.

Some concern has been expressed regarding the permanency of the wooden grid, since no preservative treatment is given the frame members. This method has been in use since 1939 on the Arroyo Seco Parkway in Los Angeles, and no failures due to rotting or weakening of the grid have taken place. It is probable that ground cover plant roots have by this time so permeated the soil that the supporting effect of the wooden frames is no longer required.

Since the areas given Type A Stabilization treatment are invariably covered by a sprinkler system, a rapid and lush growth of ground cover plants takes place soon after installation. Periodic applications of commercial fertilizer are made in order to keep the plants growing well, and an occasional

UPPER—Type A stabilization during construction. Topsoil is cast on by dragline. (Seventh Street Interchange, Santa Ana Freeway, Los Angeles.) LOWER—Established ground cover planting on Type A Stabilized 1:1 cut slopes. (Arroyo Seco Parkway, Los Angeles to Pasadena)

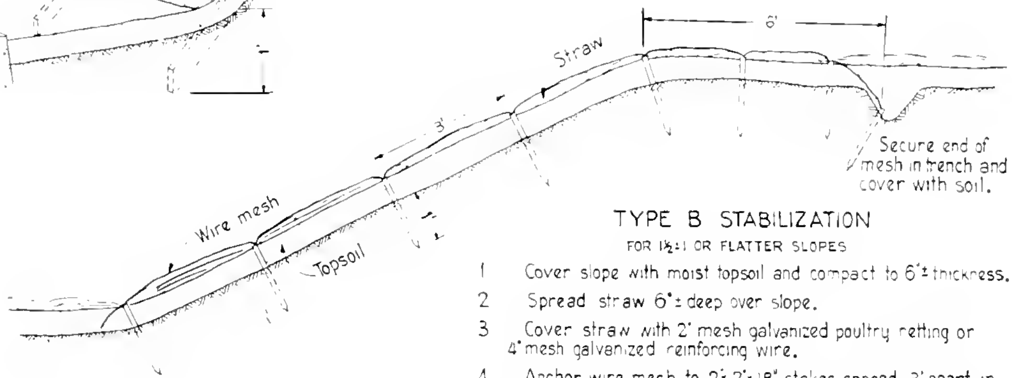
SLOPE STABILIZATION



TYPE A STABILIZATION

FOR 1:1 OR FLATTER SLOPES

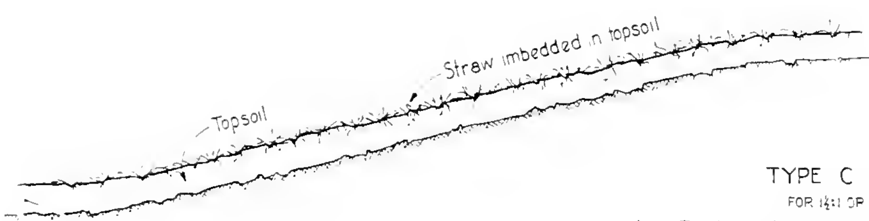
1. Lay soil retaining frames on slope and nail securely. On slopes over 15' high (slope distance) anchor frames to slope to prevent buckling.
2. Attach 14 gauge galvanized tie wires for anchoring wire mesh.
3. Fill frames with moist topsoil and compact the soil.
4. Spread straw 6"± deep over slope.
5. Cover straw with 14 gauge 4" mesh galvanized reinforcing wire. Secure mesh tightly to frames with tie wires.
6. Secure wire mesh at least 6' back of top of slope.
7. Plant ground cover plants thru straw into topsoil.



TYPE B STABILIZATION

FOR 1½:1 OR FLATTER SLOPES

1. Cover slope with moist topsoil and compact to 6"± thickness.
2. Spread straw 6"± deep over slope.
3. Cover straw with 2" mesh galvanized poultry netting or 4" mesh galvanized reinforcing wire.
4. Anchor wire mesh to 2"×2"×18" stakes spaced 3' apart in staggered rows with tie wires. Tying prefered to nailing to stakes.
5. Plant ground cover thru straw into topsoil.
6. If slope is to be seeded sow seed before placing straw.



TYPE C STABILIZATION

FOR 1½:1 OR FLATTER SLOPES

1. Roughen cut slopes on a rough contour with a scarifier or cultivator type implement in a series of longitudinal grooves or corrugations.
2. Cover cut slopes with 3"± to 6"± of topsoil. If topsoil is not available cultivate slope 4" to 6" deep and apply fertilizer. Fill slopes will not ordinarily require topsoil or cultivation unless very sterile or compacted.
3. Cover slope with straw at rate of 4± tons per acre. Imbed straw into loose soil with a sheepsfoot roller.
4. Plant ground cover thru straw into topsoil.
5. If slope is to be seeded sow seed before placing straw.

PREPARED BY
LANDSCAPE SECTION OF THE DESIGN DEPT.
CALIFORNIA DIVISION OF HIGHWAYS

Type B stabilization treatment ready for ground cover planting

clipping or mowing to remove excess or old growth has been found to be necessary.

The only failures experienced on the Arroyo Seco Parkway installations of Type A Stabilization resulted from uncontrolled and concentrated drainage water from areas above, which caused narrow and confined washouts. Also, at bridge abutments where the backfill was not thoroughly compacted, loss occurred when that particular area was overwatered immediately following installation of stabilization.

The cost of installing Type A Stabilization, based on bids received in February, 1948, is about $1.45 per square yard. This figure also includes the cost of furnishing and placing topsoil in the frames. Ground cover plants will add about $0.05 per plant, or if planted 12 inches apart, $0.45 per square yard to the above cost.

Well roughened cut slope ready to be topsoiled

TYPE B STABILIZATION

This method for stabilizing $1\frac{1}{2}:1$ or flatter slopes was developed for use on urban freeways in locations where any soil loss whatever could result in a traffic hazard. (*See Slope Stabilization Detail Sheet.*) A slope which is constructed at the top of a retaining wall or which is close to adjacent improved property must be positively controlled, since damage claims or danger to the traveling public could result if any portion of the slope failed. A thick layer of straw held firmly in place by anchored strips of wire mesh effectively prevents the two types of soil movement—surface loss and slippage. After vegetation has become established, permanent stabilization is a reality.

This procedure, while extremely effective, is too costly for general use on rural highway roadsides where the consequences of soil loss are not generally immediately serious. The cost, based on bid prices received in February, 1948, is about $0.90 per square yard. This figure includes the furnishing and placing of topsoil, but does not include the cost of seed or ground cover plants.

Spreading and smoothing topsoil on a roughened slope

TYPE C STABILIZATION FOR SLOPES

This is the method most commonly used for stabilizing highway cut and fill slopes. (*See Slope Stabilization Detail Sheet.*)

Cut slope roughening, to be most effective, should be done with a scarifier or cultivator type implement as excavation progresses and before the newly exposed subsoil dries out. The roughened slope should show corrugations on a rough contour. When the soil becomes saturated, these corrugations tend to break up the smooth slippage plane which forms between the layer of topsoil and the relatively impermeable subsoil.

Maximum compaction of the surface layer of soil by rolling with a sheepsfoot roller can only be obtained when the soil contains the optimum amount of moisture, as determined by soil compaction tests. Normally only one round trip of the roller is required, though additional rolling may be done if it appears that a greater degree of compaction would be desirable. In this event, the rate of application of straw must be increased, since each pass of the roller presses a small amount of straw beneath the surface of the soil, and it is essential that enough straw remain unburied to afford surface protection.

Experience has revealed that on $1\frac{1}{2}:1$ cut slopes, there are apt to be fewer failures during the first heavy rains if the topsoil blanket is restricted to approximately two inches to three inches in thickness. Thicker coverage tends to saturate, become heavy, and slip. As the degree of slope lessens, the depth of the layer of topsoil can be increased if desired.

Spreading straw on newly topsoiled slope

Brush layers and wire reinforced brush mats installed in a fill during construction. These mats have been allowed to protrude too far. Note rock protection at toe of slope. (City Creek Road, San Bernardino County)

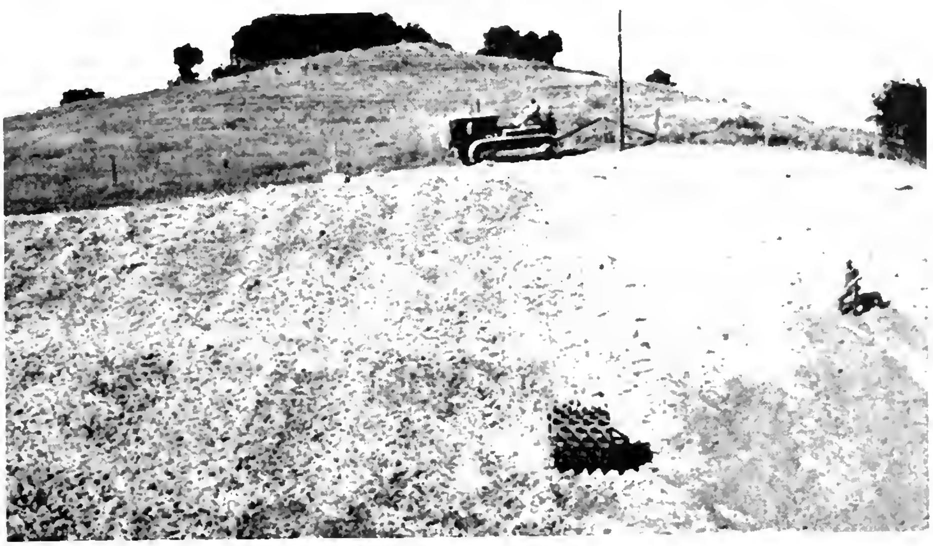
The cost of Type C Stabilization, based on a number of 1948 and 1949 bids, averages as follows:

Slope preparation or roughening	\$0.08 per sq. yd.	\$387.20 per A.
Straw at 4 tons per acre	55.00 per ton	220.00 per A.
Total		\$607.00 per A.

Add the cost of seed or ground cover plants.

The price paid per ton for straw includes the cost of furnishing, spreading and rolling. The cost of handling and spreading topsoil does not appear.

Spreading straw and rolling $1\frac{1}{2}:1$ cut slope with cable-controller sheepsfoot roller. (Vicinity of Salinas)



since this item is included in Roadway Excavation quantities, and is paid for as such.

Commercial fertilizer, to be applied at the rate of 30 pounds to 40 pounds per 1,000 square feet averages about $85 per ton. A complete fertilizer having an analysis of 6-9-6 or 6-10-4 is usually specified.

BRUSH LAYER METHOD FOR STABILIZATION OF EXTREMELY ERODIBLE FILL SLOPES

This method was developed for use during construction in stabilizing fill slopes composed of erosive soils in regions where rainfall intensities are high. The function of the brush layer is to minimize formation of gullies, in the event the surface protection fails, by disbursing the stream and reducing the velocity of the runoff water.

In order to simplify the detail sheet, the term, "Brush Layer," has been used throughout the specification, though actually other materials have, at times, been used for this purpose. These variations are discussed below.

In addition to the installation of brush layers or mats, this method differs from Type C Stabilization procedure in that a heavier application of straw and additional rolling with a sheepsfoot roller are specified. Excellent compaction is obtained below the outer 2 inches by thoroughly rolling each portion of the slope, and the comparatively uncompacted outer two inches are so mixed with straw that the tendency to wash is minimized.

Our specifications require that the complete stabilization treatment be given fill slopes at stages during fill construction in order that no extensive area of unprotected slope shall be exposed to damage from unseasonal cloudbursts which sometimes occur in the mountains of Southern California.

Two Alternatives

When brush is not readily available, at least two alternatives are possible:

1. Straw Mat. Lay 1-inch-mesh galvanized netting or fencing on the prepared fill bench surface. The mesh should extend into the fill about five feet. Spread straw on the mesh to such depth that after compaction the finished mat will be approximately 4 inches thick. Proceed as for "Brush Layer."

Rolling 10-foot strip of fill slope after application of straw. (City Creek Road, San Bernardino County)

2. *Wire Mesh Mat.* Lay 60-inch-wide, 4-inch-mesh, galvanized fencing on the prepared fill bench surface. On top of this, lay several courses of War Surplus Camouflage Netting (green-painted steel wool fastened to poultry netting), or small-mesh poultry netting. Proceed as for "Brush Layer."

A more elaborate, denser, and presumably structurally stronger form of the Brush Layer has been used in Southern California:

Wire Reinforced Brush Mat. Lay 60-inch-wide, two-inch to four-inch-mesh galvanized fencing on the prepared fill bench surface. Place brush on wire, leafy ends outward, to such depth that after compaction the finished mat will be from four inches to six inches thick. Lay wire mesh on top of brush and tie edges together at one-foot intervals with 16-gauge galvanized wire. Tie along center and at quarter points at three-foot intervals. Stake sufficiently to prevent slipping under additional fill. Proceed as for "Brush Layer."

This type of mat may be used in conjunction with brush layers in locations where conditions are extreme.

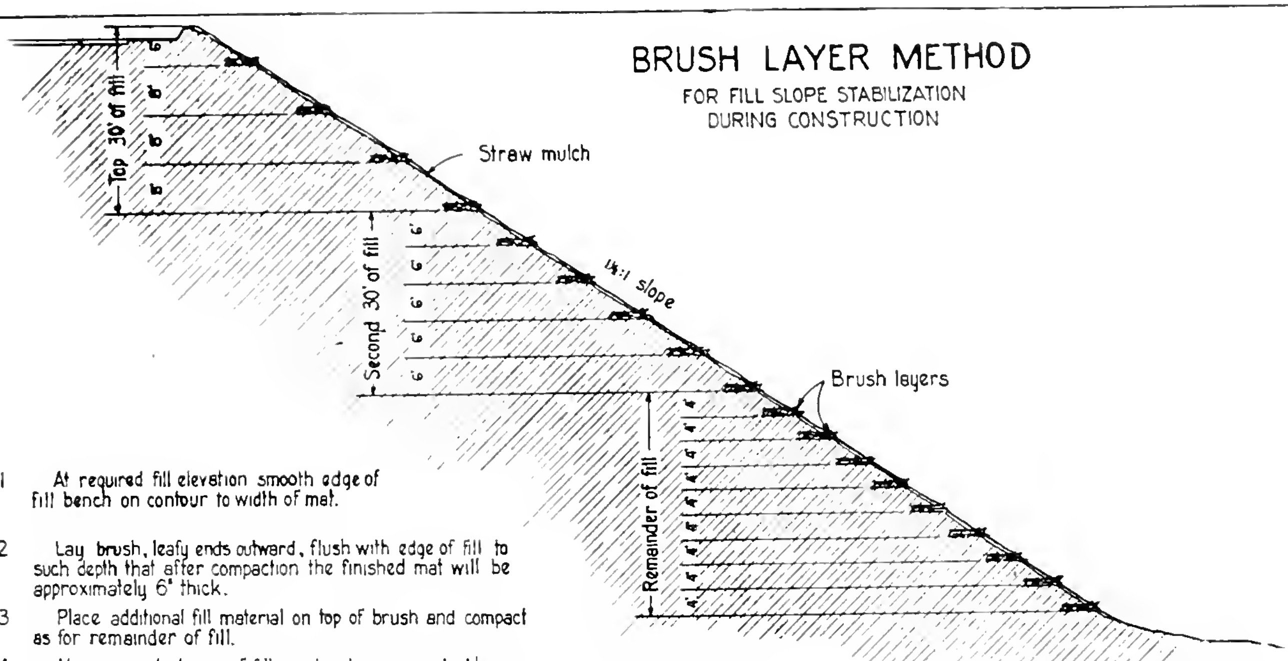
Reinforced Brush Mat

On low embankments and the upper portions of high slopes, every fourth brush layer is replaced by a wire reinforced brush mat, and as the distance from the top of the fill becomes greater, this interval is reduced until

Rolling low fill slope after completion of roadway. Roller is towed by the boom cable and held in position by a second cable attached to the uphill side of the yoke. (In this case, straw was applied to protect sand slopes from wind erosion.) (Near Colton, San Bernardino County)

BRUSH LAYER METHOD

FOR FILL SLOPE STABILIZATION
DURING CONSTRUCTION



CROSS SECTION

1 At required fill elevation smooth edge of fill bench on contour to width of mat.

2 Lay brush, leafy ends outward, flush with edge of fill to such depth that after compaction the finished mat will be approximately 6" thick.

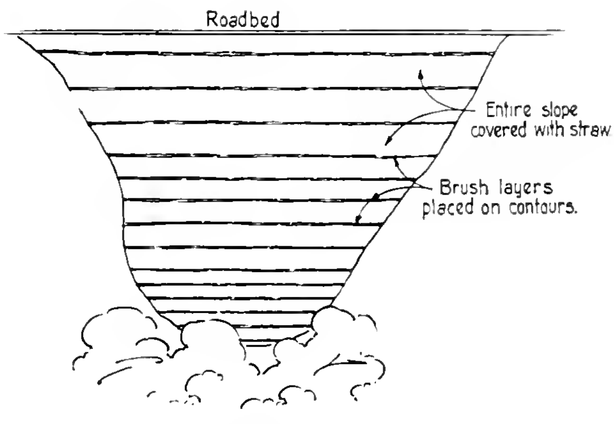
3 Place additional fill material on top of brush and compact as for remainder of fill.

4 At convenient stages of fill construction spread straw evenly over slope at rate of *4 tons per acre. Roll with a sheepsfoot roller operated vertical to the plane of the slope until straw is thoroughly incorporated into the soil. At least 4 round trips of the roller will be required.

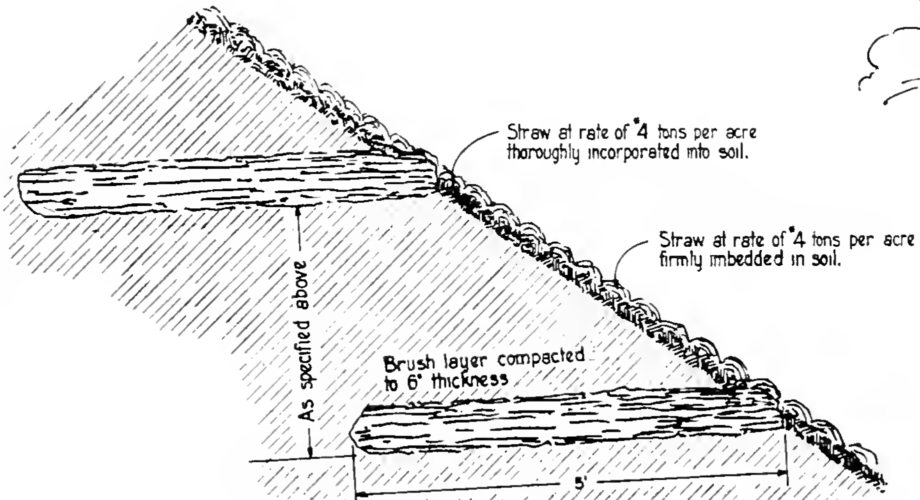
5 Sow evenly over the slope a mixture of 50 % Barley, 45 % Rye grain and 5 % Alfalfa seed by weight at rate of 200 lbs. per acre.

6 Spread second application of straw at rate of *4 tons per acre. Repeat rolling operation until straw is firmly imbedded in soil.

7 Plant live cuttings of Baccharis and Willow, or cuttings and seed of hardy varieties of plants indigenous to the locality, between mats for permanent vegetative protection.



SIDE ELEVATION



DETAIL SECTION

* The total quantity of straw applied per acre will vary according to the character of the fill material. Loose, granular, disintegrated granite soil usually requires more straw per acre for an adequate cover (6 to 10 tons per acre) than does soil of a loamy character (4 to 8 tons per acre).

Surface slippage due to saturation caused by a 6-inch rainfall in 24 hours. (Vicinity of Salinas)

every third and, finally, every second layer consists of a reinforced mat.

In sections where brush is scarce, wire reinforced brush mats or wire mesh mats have recently been installed at 15-foot vertical intervals in low embankments and the upper portions of high embankments, and at 10-foot vertical intervals in the lower portions of the high slopes. No intermediate brush layers were used in these sections.

When wire mesh or fencing is used, the outer edge should be laid far enough inside the ultimate slope line that it will not be damaged during the rolling operation. Lengths of fencing should be overlapped and fastened together in order to take advantage of any structural strength and resistance to slumping which the wire may offer. The wire mat may then extend continuously for the full length of the fill, plus a short distance beyond the intersection of the embankment slope and original ground where it should be secured.

Standard Practice

The interval between brush layers or mats as shown on the detail sheet is not critical, and may be increased or decreased to suit variable soil and climatic conditions.

It has now become standard practice to supplement this elaborate type of slope protection treatment with a

Sections from which topsoil has slipped were repaired with fertilizer, seed and straw and are now successfully stabilized. (Near Castroville, Monterey County)

Gullies on a $1\frac{1}{2}:1$ topsoil cut slope caused by runoff from adjacent property. An intercepting ditch and downdrain are needed here. (Balboa Freeway, San Diego)

planting project which is carried on concurrently with the construction contract. During the season when enough moisture is present in the soil to support plant growth, state forces plant cuttings of Baccharis or willow and seed and plants of suitable shrubs and trees on fill slopes as soon as the slope treatment is completed. This procedure has proved much more satisfactory than inclusion of the planting as a contract item in the construction contract, since the day labor work order under which the work is financed can be extended beyond the contract completion date, and the work may, therefore, be suspended if planting conditions are not favorable.

. . . Continued on page 64

Prison Labor

Story of Highway Road Camps in the State of California

By G. A. TILTON, JR., Supervising Highway Engineer

This is the seventh and concluding article of a series appearing in *California Highways and Public Works*, recording the history, legislation and continuous administration of state highway prison road camps in California since 1915. The six previous articles include:

The following article covers construction features involved in the employment of prison labor on highway projects.

WITH CALIFORNIA'S growing population and continued development of the State Highway System in all areas of the State, it is becoming more and more difficult to find locations in remote sections that are adaptable to the employment of prison labor on highway construction.

PRISON ROAD CAMP ACTIVITIES ON DECLINE

Due to the scarcity of suitable projects, road camp activities have been steadily declining during the past 20 years with the prisoner population in the camps progressively decreasing from a peak of 700 men in seven camps during 1929-1930 to the present camp population of 200 men in three camps.*

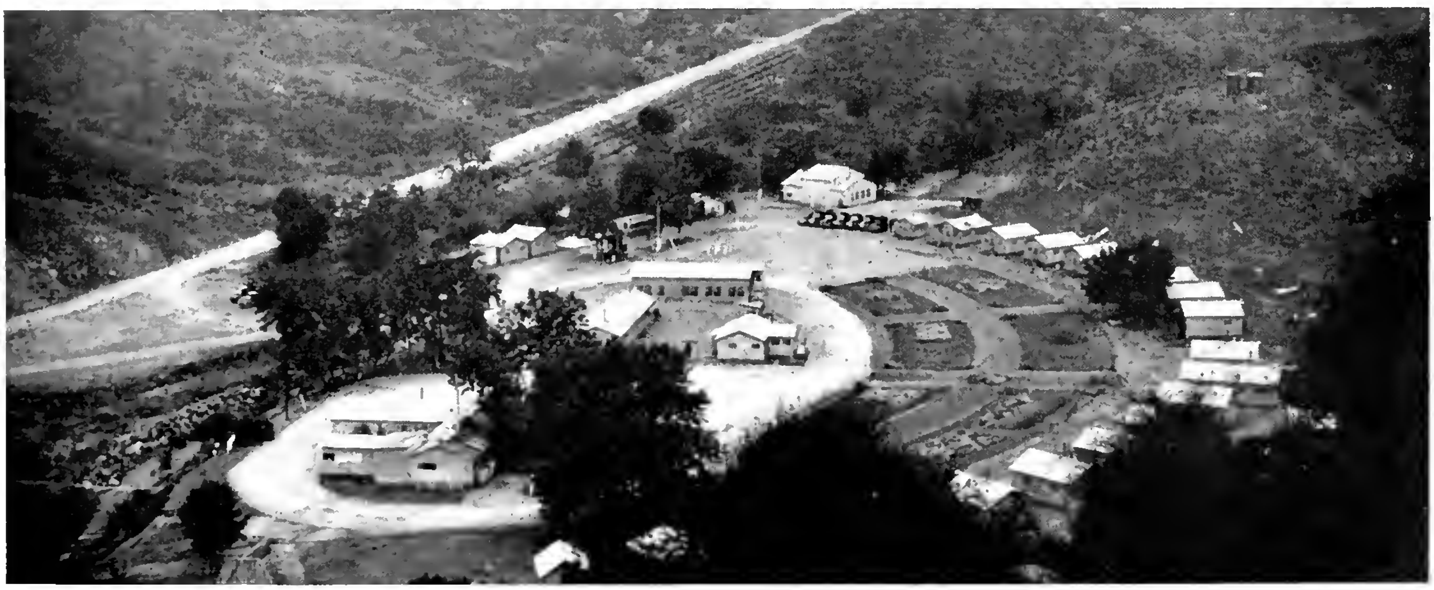
Concurrent with the reduced employment of prisoners in the highway road camps and the increase in population of the prisons, the Department of Corrections has been faced with the acute problem of developing work programs for inmates that will eliminate objectionable idleness in the institutions.

* As of March, 1950.

PRISONER REHABILITATION BENEFIT TO SOCIETY

At the present time, out of an adult inmate population of over 11,000 men, about 3,000 prisoners are being released to society each year at the rate of approximately 250 per month, and as pointed out by correction authorities, it cannot be expected that these men

Prison Road Camp No. 38 on State Route No. 77 in San Diego County



will go from prison cell to unfamiliar employment after many years of confinement and immediately make good workmen without the benefit of some conditioning process such as that offered by the road camps.

To this end, prison administrators are convinced that there should be some employment for these men other than the work that can be done within prison confines. Outdoor activities away from prison atmosphere give these men an opportunity to work the "kinks out of their backs and minds" and adjust themselves physically and psychologically before return to a diffident and often unfriendly society.

ECONOMIC BENEFITS TO STATE OF SECONDARY IMPORTANCE

The present quota of 200 inmates in the state highway road camps is relatively small in comparison to the total prison population of over 11,000 men. Although road camp inmates are self-supporting and the prison system is relieved of the cost of their upkeep in prison, the accruing economic saving to the prisons is considered to be of secondary importance when compared to the potential benefits of returning men to society with a better chance of "making good" under adverse circumstances.

CONSTRUCTION ORGANIZATION AND PROCEDURE

Consistent with the intent of legislative provisions controlling the operation of prison road camps, construction organizations for specific projects are designed to utilize inmates for common labor, and free men for supervisory positions and skilled jobs. For the average camp as presently organized, 45 free men are employed for every 100 prisoners assigned to the camps, including 10 percent utilized for camp maintenance. Construction operations are mechanized in line with efficient contract practices, and include modern power shovels, tractors, trucks, compressors, power graders, carryall scrapers and similar power equipment required for specific types of heavy construction work.

Los Angeles Crest Highway in Los Angeles County. This is typical rugged terrain adaptable to prison labor

COSTS BY PRISON LABOR COMPARABLE TO CONTRACT COSTS

Analysis of the cost of past and current highway projects employing prison labor under the California road camp pay-system bears out the fact that the cost, including all overhead costs and camp write-off, is approximately the same as that of comparable work done by the contract method.

With the cost of construction by prison labor approximating the cost by contract methods, justification for building highways with prison labor must be found primarily in benefits accruing to society and the State Prison System.

EXPENDITURES AT UNIFORM RATE

Unlike contract work, where large expenditures are made in relatively short periods, funds for prison labor projects must be allotted and expended at a uniform rate over a longer period of time to insure continuity of construction operations. The magnitude of work proposed for prison labor projects must be sufficient to satisfy both expenditure and time requirements as well as to justify the construction of an adequate camp. Projects selected for construction have, as a matter of policy, been located in remote mountainous areas whenever possible and where there is little or no competition with a free labor market.

Experience indicates that a minimum expenditure of $1,000,000 over not less than four years time is necessary to meet both economic and financing needs. Camp quotas of less than 50 prisoners have been found to be impractical under the pay-system where it is incumbent that inmates be self-supporting. If the camp quota is too small the overhead is unavoidably disproportionate to income from inmate wages.

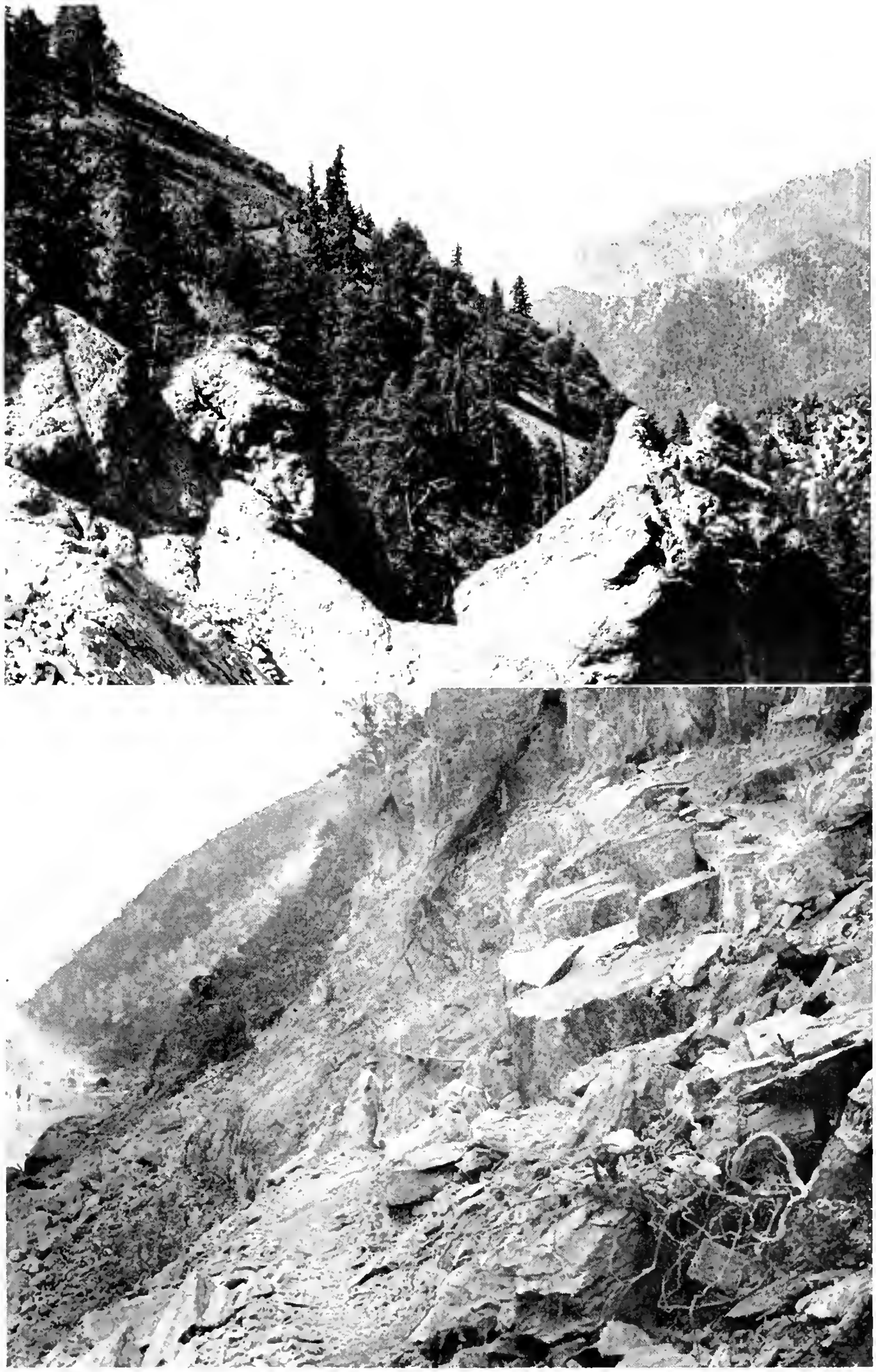
Following is a typical breakdown of current camp expenditures:

Free labor	35%
Equipment rental	31%
Explosives	8%
Construction materials	5%
Gas, oil, miscellaneous	6%
Inmate labor	15%
Total	100%

EQUIPMENT

Equipment required for construction operations over long periods of time is owned by the State and obtained upon requisition from the Division of Highways Equipment Department at established rental rates—the rental rates including repairs and depreciation but not the operating cost such as gas, oil and operator which is borne by the job allotment.

Equipment needed for short periods or in emergencies is rented from outside vendors after advertising for bids



UPPER—Islip Summit on Angeles Crest Highway in Los Angeles County. LOWER—Merced Canyon on Sign Route 140 to Yosemite Valley

as required by law and is rented fully operated, including the operator.

For the purpose of repairing and maintaining state-owned equipment, a modern equipment shop is built in each camp and maintained under supervision of the Equipment Department.

FREE PERSONNEL

All skilled free labor and supervisory personnel for the camps are furnished from civil service eligible lists selected through competitive examinations.

Typical free-labor job classifications employed on construction in the road camps include:

- Construction Superintendent
- Highway Foreman
- Truck Driver
- Power Shovel Operator
- Stonemason
- Powderman
- Carpenter
- Tractor Operator
- Power Shovel Oiler
- Blacksmith
- Heavy Equipment Mechanic
- Commissary Clerk
- Timekeeper-Clerk

Skilled labor required for emergencies and short-time jobs, such as plumbers, electricians, etc., is generally procurable from the nearest local community.

ENGINEERING INSPECTION

A resident engineer is assigned to each road camp project in charge of all engineering aspects of the job. He is responsible to the district engineer and bears the same relation to the camp construction superintendent as the resident engineer on a contract bears to the contractor.

It is the duty of the resident engineer to enforce compliance with specifications and conformance with approved plans for the project as well as determination of construction quantities.

MONTHLY PROGRESS REPORT

Efficient administration of road camp construction activities requires a current record of costs and progress. To provide this information, job expenditures are accounted for and assembled in a monthly progress report along with construction quantities, unit costs, and pertinent job data.

The progress report of project activities is compiled from job accounting records and from construction quantities measured by the resident engineer. Unit costs of construction items are determined from this information for comparison with the preliminary estimate of cost and for judging the efficiency and rate of progress of construction operations.

Each monthly report is completed as soon as possible after the first and before the tenth of each month and includes complete information on the following subjects:

(a) General Camp Data
(b) Status of Allotted Funds
(c) Narrative Report
(d) Inmate Records
(e) Free Personnel
(f) Analysis of Expenditures to Date
(g) Inventory of Construction Materials
(h) Explosive Inventory
(i) Camp Cost and Write-off to Construction Items
(j) General Expense
(k) Extra Work
(l) Monthly Analysis of Unit Costs
(m) Equipment Rentals
(n) State-owned Equipment Rentals and Outside-owned Equipment
(o) Over-all Comparison of Actual Costs to Date With Preliminary Estimate of Cost

OF INTEREST IN GERMANY

OFFICE OF THE UNITED STATES HIGH COMMISSIONER FOR GERMANY
Nutrition Mission for the Office of the Surgeon General
APO 807

February 20, 1950

Mr. G. A. Tilton, Jr.,
Department of Public Works
State of California
Sacramento, California

My Dear Mr. Tilton: Your letter of January 8, 1950, has been received. You tell of sending six copies of the September-October 1949 issue of *California Highways and Public Works* at Miss Sedgwick's request. Your kindness in sending the publications is appreciated.*

The article on Feeding and Nutritional Accounting in your series of articles on prison labor camps in California is excellent, and the best on what can be accomplished by suitable control and nutritional accounting that has been published. It contains the factual evidence necessary to be convincing. As Miss Sedgwick probably told you, I wanted the chart to give to the Germans along with the article which I had copied from the manuscript. The original paper with the inventory of stores and quarterly requisition as well as the chart on cost will be appreciated by the Germans more than the copy.

With kindest regards.
Sincerely yours,
(Signed) PAUL E. HOWE
Chief, Nutrition Mission

* Food administrator, California Youth Authority.

MODERN CONSTRUCTION PRACTICES EMPLOYED

The efficiency of construction superintendents in charge of road camps is judged primarily by the quality, progress and cost of the work under their supervision as compared to preliminary estimates of cost for each project and comparable contract work.

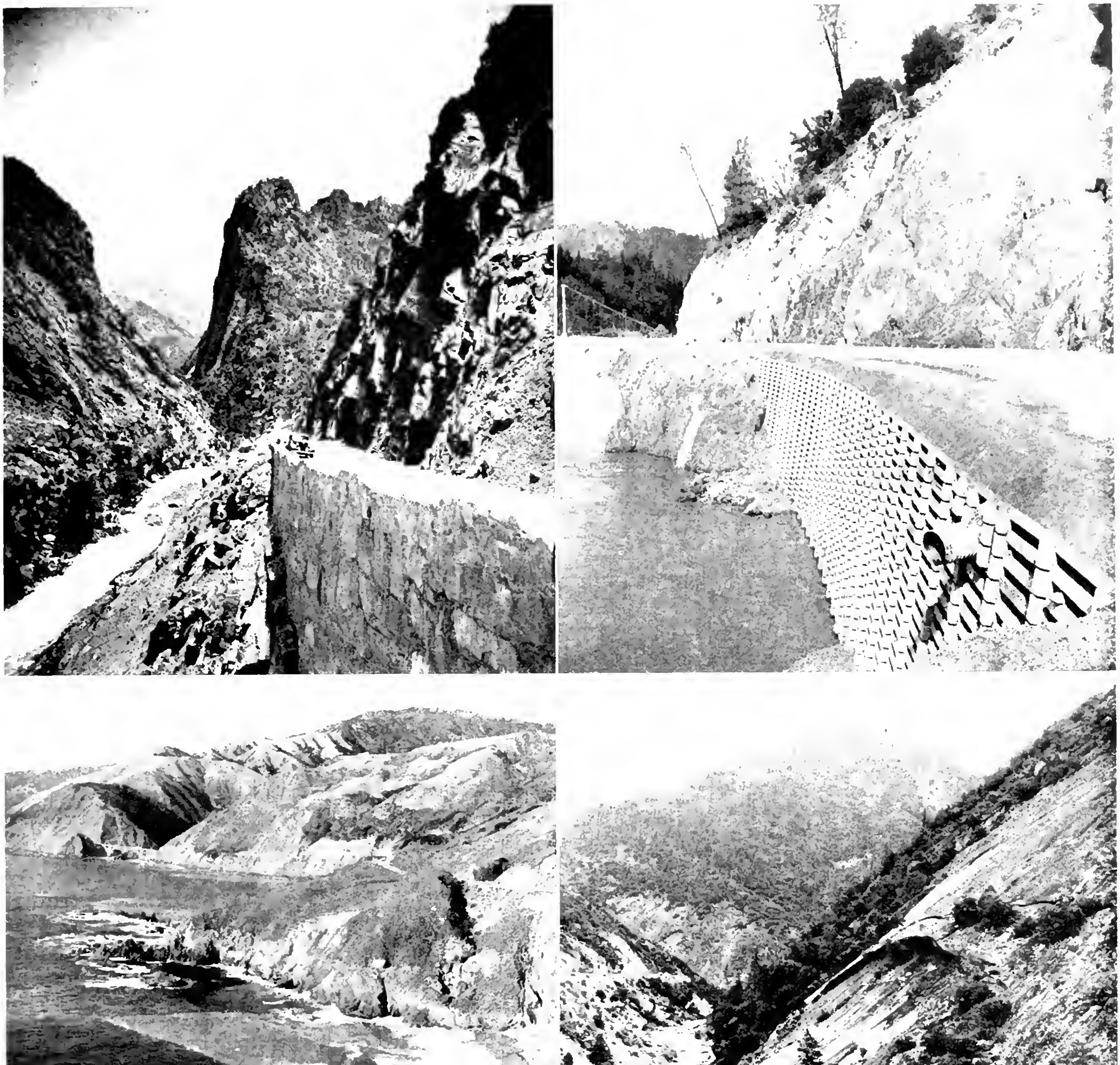
Superintendents are required to keep abreast modern construction practices and are encouraged in the development of new methods, use of improved products, and experimental investigation of specialized equipment. Likewise improvement of current construction procedures on all phases of the work is fostered. To this end, extensive time studies of power shovels and truck operations are undertaken at intervals and production records and costs compared between the various camps.

In recent experiments with newly marketed detachable alloy steel rock bits, one camp has been able to consistently more than double the drill hole footage per shift over conventional carbon steel detachable bits. Similarly, experiments with different types of explosives and loading methods have resulted in uniformly good blasting technique in the camps. Such improved methods tested in one camp are then adopted in other camps where applicable.

RELATIVE PRODUCTION OF INMATE LABOR

Contrary to popular conception, analysis of the productive labor output of prisoners under the California road camp pay-system indicates that it com-

. . . Continued on page 64



Typical rugged terrain adaptable to prison labor. UPPER LEFT—Kings River Canyon Highway, Sign Route 180 in Fresno County. LOWER LEFT—San Simeon-Carmel Highway, Sign Route 1 in Monterey County. UPPER RIGHT—Trinity Lateral, U. S. 299, in Trinity County. LOWER RIGHT—Arch Rock on Feather River Highway, Sign Route 24, in Butte and Plumas Counties

Here's Tip

New Cement-Treated Base Road-Mixed Method Used Between Sherwood Road and Sapp Creek

By H. W. BENEDICT, Assistant Highway Engineer

During the construction season of 1949 a resurfacing contract for some 8.3 miles of the Redwood Highway, U. S. 101 (State Route 1), was completed between Sherwood Road and Sapp Creek near the town of Laytonville in Mendocino County. The contract consisted of the cement treatment of existing and imported base material by road-mixed methods, surfaced with three inches of plant-mixed surfacing. This construction provided stabilization of a section of highway which was badly broken up, and which had been a serious maintenance problem for several years.

While all phases of the work were completed in a commendable manner by the contractor, that of road-mixed cement-treated base is especially worthy of comment; both for the efficient way in which the work was handled and for the final appearance of the work, which was excellent. Following is a brief resume of the methods used by the contractor to accomplish these results.

Scarifying of the existing and imported base material consisted of breaking, to the size of the largest particle in the aggregate, all that material to be cement treated. Existing material ranged from armor coat to exceedingly hard road-mixed surfacing, to which was added varying quantities of imported base, placed under the same contract. This latter consisted of crushed river gravel. At several locations the imported base material comprised the entire thickness to be cement treated. Generally, however, it was combined with portions of the existing base to make the total thickness.

The prime tool for scarifying was built by the contractor after several years of experimentation. It consisted of the frame, wheels, etc., of a LeTourneau ripper to which were welded eleven shanks from a Caterpillar No. 12 motor patrol ripper. These shanks were fitted with standard scarifier teeth. The unit was towed by a D8 Caterpillar, and proved very effective in ripping up the hardest bituminous pavement encountered on this contract. To further pulverize the larger pieces of ripped-up oil cake, a bare Caterpillar was walked over the scarified base utilizing the grinding action of the growsers with good success. A motor grader was also used in this operation to turn the scarified material for the above equipment and to reshape and re-lay the material after scarifying. This grader was also used to prepare the windrow ahead of the road-mixer.

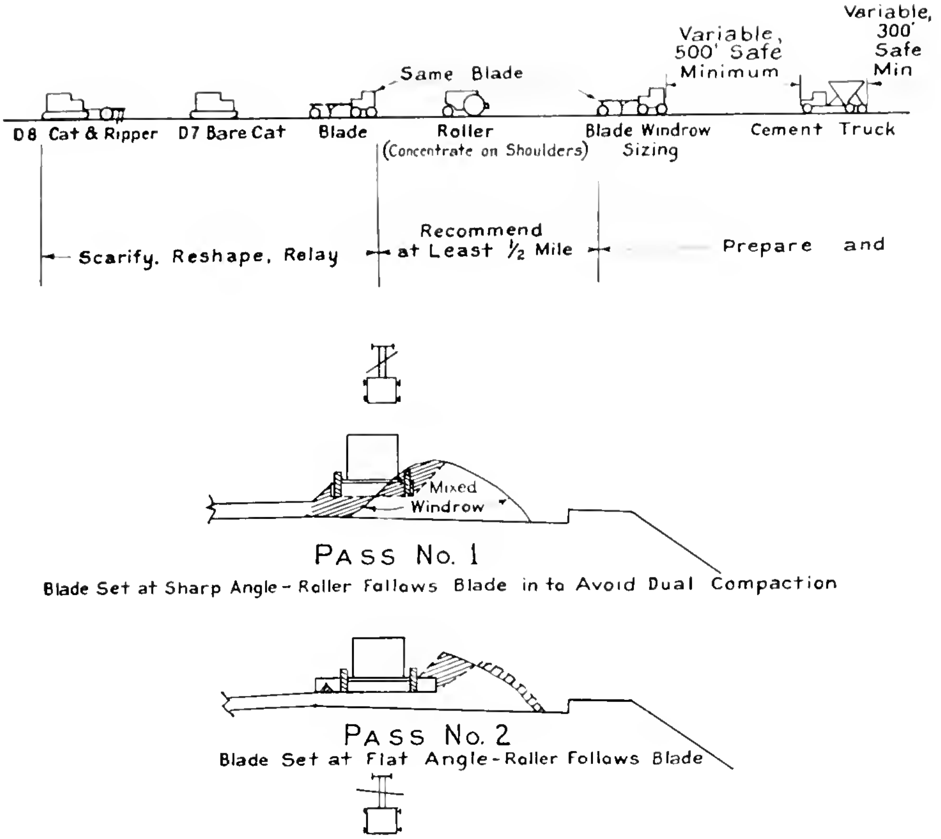
This photo shows the contractor's equipment in operation

The contractor made one miscalculation in that he did not begin his scarifying operations further in advance of mixing operations. Consequently, he was forced to work the scarifying equipment overtime to keep ahead of the mixer. In this connection, it is also believed the State is better served when the operations are well spread out, since it provides two short areas of controlled traffic rather than one long traffic control with the resultant longer delays for traffic.

Four percent of cement was added to the material to be road-mixed directly ahead of the mixer by means of a gondola truck built by the contractor. This cement spreader consisted of a three-axle drive truck on which was mounted a metal bin in the shape of an inverted pyramid. This bin held two cans (10 tons) of cement, and was loaded at a central storage area by a dragline which also served to unload the cement cans from transport trucks.

Cement was distributed on the windrow by an ingenious rotary valve mounted at the outlet of the cement bin. Quantities of cement could be very closely controlled by means of simple gear changes on the chain drive of the rotary gear. This proved to be an economical and highly satisfactory method of adding cement.

Mixing of the prepared base was done with a Woods 54-inch road-mixer, towed by a D8 Caterpillar tractor equipped with a special transmission and power take-off so integrated as to provide a forward move-



This diagrommatic sketch and the one on the page following show types of equipment, arrangement, and spacing, and method of laying out road-mixed cement treated base

ment of about 20 feet a minute with the mixer fully loaded.

The machine mixed one traffic lane at a time, in this case a section 12 feet wide. In some cases the compacted depth was five inches and in others it was six inches. It readily mixed the heaviest windrow which consisted of approximately 7.2 cubic feet of uncompacted aggregate per lineal foot. The machine was stalled on only two locations where the windrow had been poorly sized and contained approximately nine cubic feet of uncompacted material.

Water Distribution

Water was furnished the mixer by means of a water truck towed directly behind the mixer by a quickly detachable tow bar. The water was pumped from the truck through a meter to spray bars within the mixing drum. The quantity of water added to the mixer was controlled by tables prepared by the engineer integrating the rate of flow with the speed of the machine, the size of the windrow, and the moisture content thereof. After some experience with the machine, moisture content could be determined very closely by feel and touch. Laboratory tests showed this method to be very reliable; it being the first job in the writer's experience when it was not necessary to remove over-watered "quakey" spots in the finished base.

After poor results were obtained in an attempt to use a home-made self-propelled spreading device to lay out the mixed base material, the contractor elected to use a Caterpillar No. 12 motor grader to spread the windrowed cement treated base. This method proved economical and produced a true section under the conditions encountered on this contract. It was immediately obvious that the entire progress of the work depended upon the skill and ability of the individual operating this grader since the travel of the Woods mixer could not exceed the spreading of the processed material. The contractor was fortunate in having an extremely capable operator who managed to handle the material as fast as it was mixed and yet complete the process in a manner acceptable to the inspectors.

To facilitate the above, the superintendent and engineer realized that an orderly method of spreading should be devised. Accordingly, a method was developed which both satisfied the specifications and allowed for the rapid completion of the operation. This method of laying out the material is best described by diagrams which are attached to this report.

Compaction was obtained with two 12-ton three-wheeled rollers. The first worked in close conjunction with the spreading grader; the second completed the initial rolling. The material was then trimmed by another motor grader, after which the base was given the final rolling with a contractor-constructed rubber-tired roller, conforming to specifications for this type machine.

Sealing of the completed base was accomplished in the usual manner, the contractor using a 1,300-gallon boot truck to spread the asphaltic emulsion, and a Buckeye spreader to distribute the sand.

However, this operation differed in some respects from the usual in that the contractor stockpiled sand for the curing seal at various locations on the job. This procedure obviated the usual costly delay while the sand truck was returning to the plant for sand.

As a result of the above well-planned and well-coordinated operations, and the selection of adequate machines and skilled operators, the contractor was able to complete the cement treated base and related items of work in a length of time far shorter than that previously experienced in this district.

... Continued on page 48

OCEANSIDE-CARLSBAD FREEWAY IS APPROVED

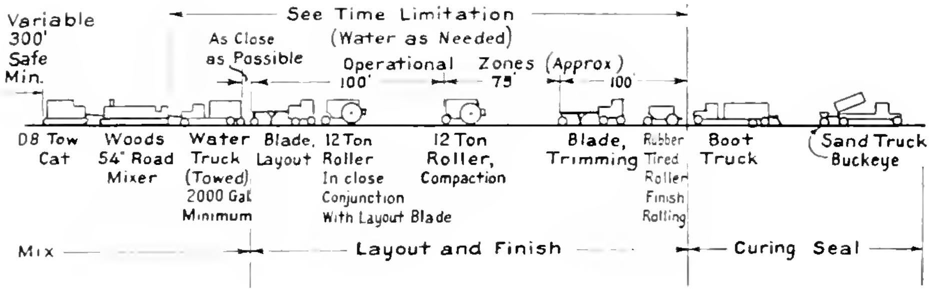
The California Highway Commission at its meeting in Los Angeles on May 19th unanimously authorized the construction of the $6,000,000 freeway on U. S. 101, through Oceanside, South Oceanside and Carlsbad, from the San Luis Rey River to a point one mile south of Carlsbad. The adopted route has been referred to as the "Red Line." The Highway Commission estimates that the route may be placed in service approximately three years subsequent to the initiation of the project and is prepared to budget funds to begin construction as soon as freeway agreements may be made with local governing bodies.

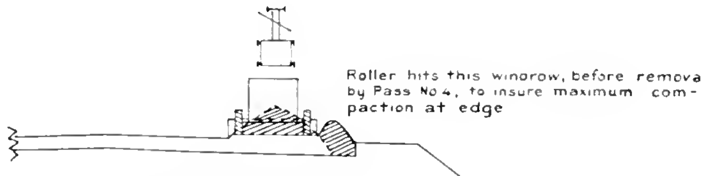
Project Statistics

Following, in outline form, are the more important statistics on this phase of the contract:

Total square yards CTB mixed	118,316 sq. yds.
Equivalent tons CTB mixed (at 140 lbs. cu. ft.)	32,120 tons
Working days to complete CTB	12.5 days
Working hours to complete CTB	102 hours
Average tons CTB mixed per day	2,570 tons
Average tons CTB mixed per hour	315 tons
Maximum tons CTB mixed per day (approximate)	3,100 tons
Rate of travel of Woods mixer, average	18.7 ft. min.
Rate of travel of Woods mixer, maximum	20.0 ft. min.
7-day test specimens—	
High	1,400 lbs. sq. in.
Low	680 lbs. sq. in.
Average	1,054 lbs. sq. in.
28-day test specimens—	
High	1,770 lbs. sq. in.
Low	745 lbs. sq. in.
Average	1,211 lbs. sq. in.

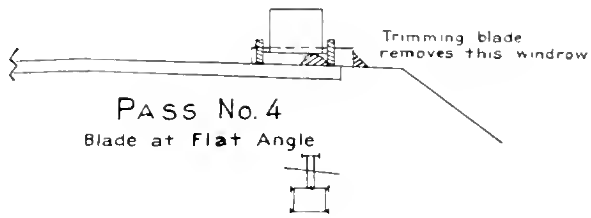
Contractor Clements & Company was represented on the contract by Superintendent J. R. Paselk; the State by Resident Engineer H. W. Benedict, assisted by R. J. Datel on tests and Jack R. Rowe, Street Inspector.





PASS No 3

Blade at Sharp Angle - Roller Follows Blade



PASS No. 4

Blade at Flat Angle

In Memoriam

ROBERT MELLOUS HAVERSTICK

Friends of Robert Mellous Haverstick were shocked and saddened to learn of his sudden death on Saturday, May 13, 1950. He was on the job as survey party chief for District VII, State Division of Highways, the early part of that week, becoming ill Wednesday evening and losing consciousness the following morning. He was then taken to the Queen of Angels Hospital in Los Angeles where he remained in a coma until his death.

Everybody knew him as "Bob" Haverstick. He was one of the most colorful and beloved personalities in the District VII engineering staff. He was born in Los Angeles, July 25, 1890. He was a descendant of the old pioneer Mellous family, which helped make early Southern California history.

Bob's association with District VII dates back even before the beginning. The nucleus for District VII appears to have existed in the personnel of the Los Angeles County Road Commission's 1909 organization. At that time the county road commission had three survey parties, for one of which the chief was Spencer V. Cortelyou, the head man of District VII for so many years. In Cortelyou's party one of the chainmen was Bob Haverstick. On March 15, 1912, Bob joined the Division VII (as it was then designated) organization, again working under Mr. Cortelyou, and he remained in the district organization continuously except for military service during World War I.

Very quickly Bob rose to be Chief of Survey Party and in that capacity he has had responsibility for the surveying work on some of the largest and most important state highway projects. Notably among these was the intricate and complex layout engineering on the $14,000,000 Terminal Island Freeway, built by the State for the Navy to serve facilities on Terminal Island in the Los Angeles Harbor area. With the advent of the huge postwar freeway program, Bob proved himself an enthusiastic supporter of the new methods that had to be introduced to meet the new conditions. Bob's great success with the Division of Highways can be accounted for not only because of his technical ability as an engineer but also because of his cheerful friendliness and his helpful and cooperative attitude toward everyone.

He is survived by his widow, Helen Gridley Haverstick; his son, Richard G. Haverstick; his daughter, Jean H. Coldewey; and his grandson, Jack David Haverstick. The sincere sympathy of the entire department is extended to his family.

AN ENGLISHMAN WRITES ON FEDERAL AID

By REES JEFFREYS, London *

THE TWO interesting and important articles on federal aid in the last two issues of *California Highways and Public Works*, one by Mr. C. H. Purcell and the other by Mr. R. F. Reynolds move me to write a short note which may be of interest to your readers.

My first visit to the United States was in 1912. As the Secretary of the British Road Board, I had been appointed Hon. Secretary of the Third International Road Congress to be held in London in 1913. I was authorized by the British Government to visit the United States to interest the highway authorities in the London congress and, incidentally, to study the highway system of the U. S. A.

I was the guest in Washington of Mr. Logan Waller Page, then Secretary of the Highways Department of the Ministry of Agriculture. That department had very few powers and little money to spend. It occupied itself mainly in trying to inspire and instruct the state and city highway authorities in road construction. Among other activities it ran a "Good Roads" train equipped with men and appliances to instruct the authorities how to make roads. At that time a system of designed and metaled highways connecting the towns did not exist. A highway connecting New York and San Francisco was regarded as a visionary's dream.

Early Federal Aid

The question of federal aid had then been raised in Congress and at the request of Mr. Page I attended a meeting of a committee of the Senate under the chairmanship of Senator Burnham on June 13, 1912, and was invited by them to give any information about our experiences in Great Britain which might be useful. I did my best to encourage the committee to proceed with the scheme of federal aid. It was only too apparent that no great progress would be made in the United States until the Federal Government came to the assistance of the state authorities with federal aid under a properly designed scheme which would secure that roads were constructed and improved on a national plan and that the states would then be responsible to maintain them in good condition.

It was not until 1916 that the first Federal Aid Road Act became law. Its weakness was that it made all post roads eligible for grants, and it was not until 1921 that experience put the federal aid scheme on a sound basis. In the interval Mr. Thos. H. MacDonald had been made Chief of the Bureau of Public Roads. Followed the miraculous development of highways in the U. S. A. which I have ventured to class as one of the modern miracles of our time.

International Road Congress

In 1930 I attended the International Road Congress held in Washington and at the final banquet in responding to the toast proposed by Mr. Arthur M. Hyde, Secretary of Agriculture, I said:

"In 1912 you were behind Western Europe in your road systems—now you are in front. In 1912 you could teach us little—now we come to the United States from all parts of the world to learn the best methods of road construction, to examine the most up-to-date machinery."

I remember making contact over 30 years ago with Mr. A. B. Fletcher (a predecessor of Mr. Purcell), who, after leaving California, was sent to England in 1924 by the U. S. Bureau of Public Roads to make an intensive study of highway and transport conditions. I was glad to be of some assistance to Mr. Fletcher during that visit.

In 1931 by the courtesy of Mr. Purcell I made a study of the California Highway System which I traveled from the Mexican border via San Diego, Pasadena and Merced to Sacramento and thence to San Francisco. Among the district engineers I particularly recall for their courtesies are Messrs. Skeggs, Wallace and Cortelyou.

Mr. Purcell showed me the plans for the new bridge from San Francisco to Oakland, a marvelous scheme so efficiently and quickly carried out. In contrast, I have been associated with efforts to put a bridge across the Lower Severn to connect England with Wales, which after 30 years is still unbuilt.

It is the imaginative realization of what traffic requires, skill in planning and speed in execution, which has given to California, in my experience, the outstanding highway administration of the world.

* Author of "The King's Highway."

Out of the Mail Bag

FOREST SERVICE LETTER

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: I want to compliment you on your magazine, its factual articles, and its fine photographs. Our staff members, especially those concerned with the problems of watershed management, look forward to the receipt of *California Highways and Public Works*, and frequently comment on the excellent presentation of your subject matter.

Very sincerely yours,
STEPHEN N. WYCKOFF, Director

APPRECIATES INDEX

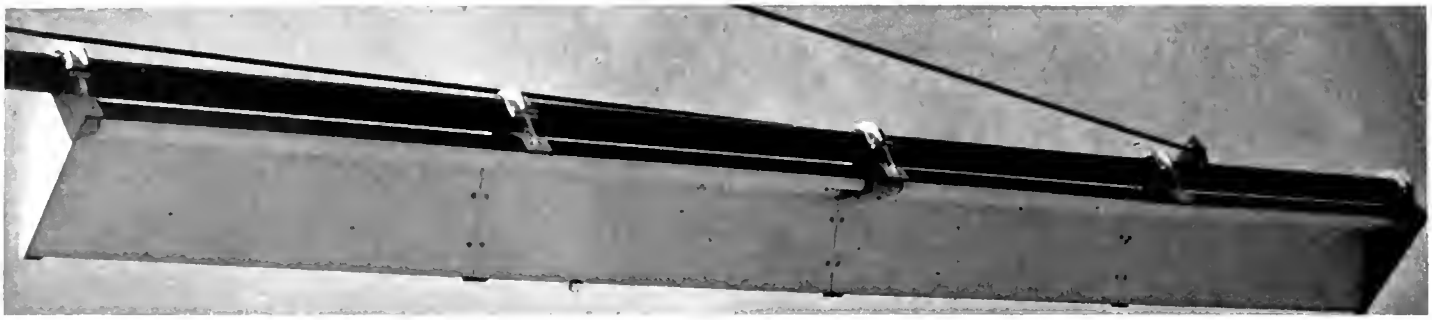
PORTLAND CEMENT ASSOCIATION
Chicago 10, Ill.

KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: You will never realize how very much surprised I was to find an index for *California Highways and Public Works* for 1949 placed in the back of the January-February, 1950, issue. You will never know what a big help this is to those of us in specialized library work who use your magazine daily for reference and research work.

During the past several years I have had to index this periodical myself in order to keep track of the various activities on the West Coast, especially in the State of California. I do not know, of course, how many libraries receive *California Highways and Public Works*, but I do feel that you have given the library profession a great help in supplying an index for your publication. I, for one, am very grateful and wish to say "thank you" to you.

Yours very truly,
P. B. SHEFFIELD, Librarian



Fluorescent luminaire showing details of reflector

Intersection Lighting

Continued from page 33 . . .

vapor lamp as used in present-day luminaires.

Intersection Illumination

Personnel of the Traffic Control Section of the Traffic Department of the California Division of Highways recently designed and had manufactured a lighting unit specifically for highway intersection illumination. This luminaire uses four of the new lamps and is designed to direct the light in one direction only. In accordance with the American Standard Practice, the location for an intersection light is on the far right corner as one approaches the intersection. This produces a bright area on the pavement in the intersection and enables the approaching driver to see objects in the intersection both by direct illumination and by silhouette.

The ordinary street lighting luminaire is designed for continuous lighting of the street and consequently directs the light equally in both directions. When it is mounted on the far right corner of the intersection the light which is directed into the intersection appears as a bright pattern on the pavement for the approaching motorist. The light which is directed away from the intersection is reflected away from the approaching motorist and is of little value in building up pavement brightness.

It seems reasonable, therefore, that for intersection lighting a luminaire which directs the main portion of its light into the intersection would be more efficient.

Major Advantage

Another major advantage of the 16-foot long fluorescent luminaire is that the wide brightness pattern on the pavement is not affected by a wet pavement surface and there are no excessively bright streaks on the pavement as is so often the case with ordinary street lights on a rainy night.

The luminaire, Type 100, was manufactured for the Division of Highways by Smoot-Holman and Company of Los Angeles. The unit as designed is approximately 16 feet long, and the reflector is a paracyl shape with white porcelain enameled facets to reflect the light rays. Four eight-foot fluorescent lamps are used. The unit is supported at right angles to the traveled way and approximately 28 feet above the pavement by a 20-foot, 3-inch horizontal mast arm.

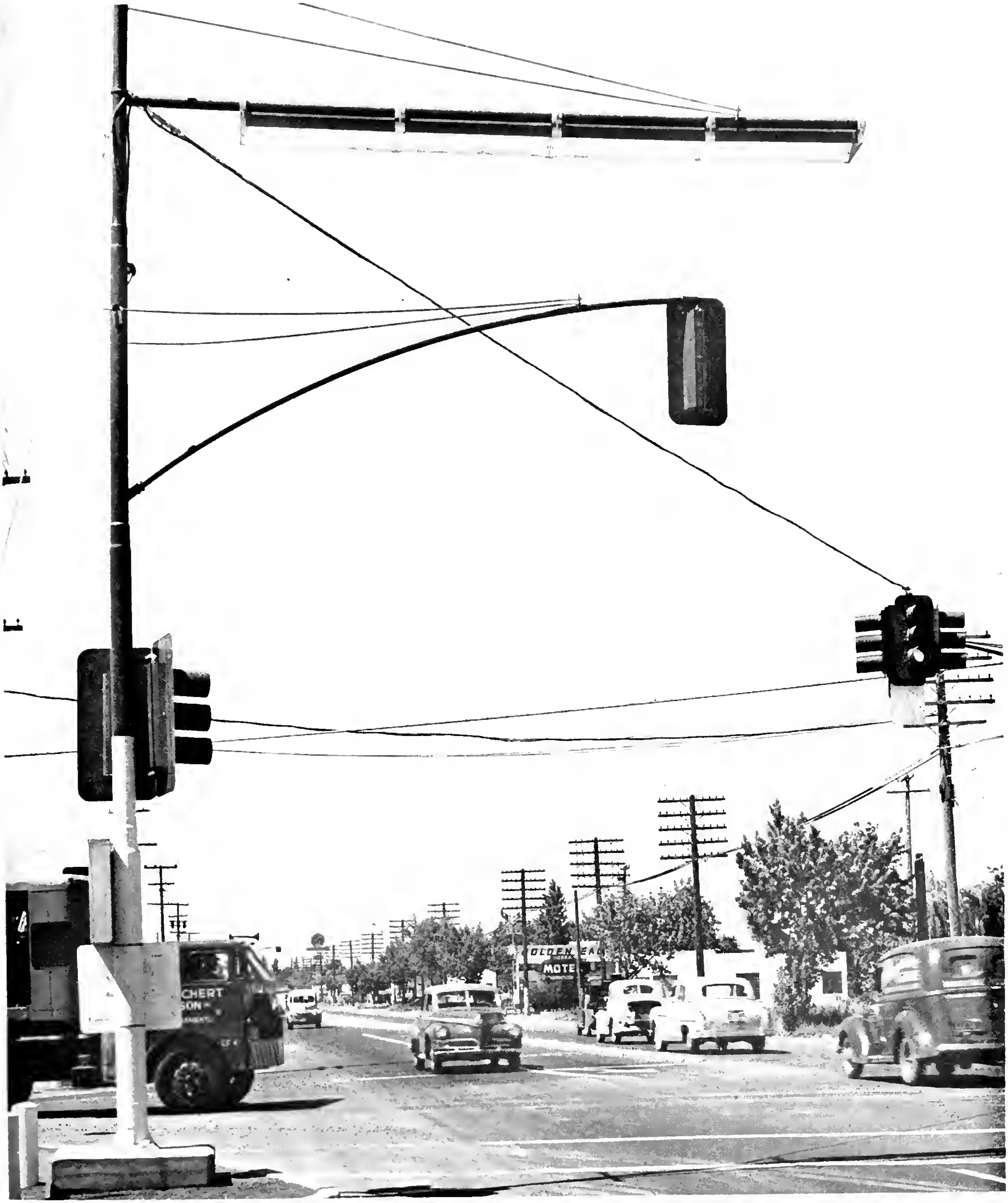
The new luminaire is installed at the intersection of Fruitridge Road and Stockton Boulevard, on U. S. 99 in Sacramento County.

The new traffic signal at this intersection is of the latest type and employs an electronic dispatcher. This dispatcher is traffic actuated and automatically adjusts itself to and takes fullest advantage of the variations in traffic volumes and densities on all of the approaches to the intersection.

A count is taken of every vehicle approaching the intersection, whether it be on the green period or the red

. . . Continued on page 63

Stockton Boulevard and Fruitridge Road, showing nonglare appearance when illuminated



View of fluorescent luminaire as seen by northbound motorists at Stockton Boulevard and Fruitridge Road in Sacramento County

THE CALIFORNIA HIGHWAY HAND SHOVEL

By H. L. FERRON, Assistant Stores Engineer

The California Division of Highways uses about 4,000 shovels per year. During the war years good shovels were difficult to obtain which caused the maintenance personnel to become "shovel conscious." A preliminary investigation indicated that the hand shovel presented a fertile field for investigation and improvement. This is particularly true, since the advent of power equipment relegated the hand shovel primarily to clean-up work and has eliminated to a large extent spading or earth-moving operations by hand.

Modern highway construction equipment for moving dirt and rock is usually visualized by the layman as huge power shovels, tractors and carryalls, trucks, bulldozers and other large and powerful machines. This equipment, which fascinates the "sidewalk supeintendent," is designed and constucted to move large quantities of material in a relatively short time. Part of the work, particularly some of the finishing and cleaning up, must be done with hand tools. One of the most important of these tools is the No. 2 hand shovel. This lowly "muck stick" becomes even more important and indispensable after the road is completed and turned over to the maintenance men.

One of Earliest Tools

History tells us that a hand shovel or scoop of some kind was one of the earliest tools used by mankind. Archaeologists have discovered and preserved for posterity digging tools of some description from practically every age of civilization they have had the opportunity to study. As civilization advanced and declined, the digging tools advanced and declined along with the other forms of culture. It is human nature to believe that our present culture is the zenith of all recorded time, we naturally believe that our tools are the finest in history.

Hand shovels are being produced at present by numerous manufacturers, all of which make high quality shovels and also make "competitive" grades. The "competitive" grade is the low cost shovel ordinarily available to the buying public at retail stores. Because of their lower cost, competitive grade shovels have been purchased in the past for the California Division of Highways.

Study of Shovels

One of the principal functions of the Stores Department is to determine which tools, supplies and materials are the most satisfactory for highway purposes. Surveys and tests are being made continuously to improve the quality and adaptability of many items which the users have called to the attention of the department.

The Stores Department coordinators found that one of the tools most frequently mentioned as being unsatisfactory was the hand shovel. As the shovel is one of the most generally used hand tools, an investigation was launched about two years ago to determine why they were not satisfactory. After questioning maintenance men skilled in the use of shovels, it was apparent that their complaints were justified, and they were unanimously of the same opinion as to what correction was needed. It was soon discovered that merely knowing what was wrong was not sufficient information to write a shovel specification with physical characteristics satisfactory to the workmen.

Men Express Preference

A field investigation was decided upon to obtain the answer. Several dozen shovels were procured which appeared to be closest to what the men desired. These were purchased from various hardware firms and were the products of practically all of the leading manufacturers. Each shovel was given an identifying number and the manufacturers' name obliterated to avoid any personal prejudice for trade names. The shovels were distributed at random throughout the State to various maintenance men who reported on a questionnaire after about three months use, indicating their preference on several features which were found to be controversial in the preliminary questioning. Numerous comments and suggestions were made which were helpful in the study and analysis.

After completion of the field tests, the shovels were thoroughly examined for wear and fatigue. The type of work on which each shovel had been used was of primary importance in developing a satisfactory design.

High Lift Shovel Favored

It was especially interesting to find that the major portion of highway maintenance work being done with hand shovels consisted of "mucking" or scooping loose material from ditches, shoulders, road approaches and subways; trimming around sign and guard rail posts; and loading trucks from stockpiles of premixed surfacing material, sand and rock. With one exception, very little time is spent in using the shovel as a spade. The exception is the gardeners, upon whose shoulders rest the burden of keeping the landscaped freeways, subways, and other beautified spots on the highway system pleasing to the traveling public. Their work of planting and cultivating shrubs, trees and other plants necessarily calls for a spading shovel for which the following specifications are not adaptable.

The survey and analysis indicated that a shovel with a high lift is the most desirable for almost all maintenance work. A high lift eliminates unnecessary back bending, reduces fatigue, results in more work done and a more satisfied employee.

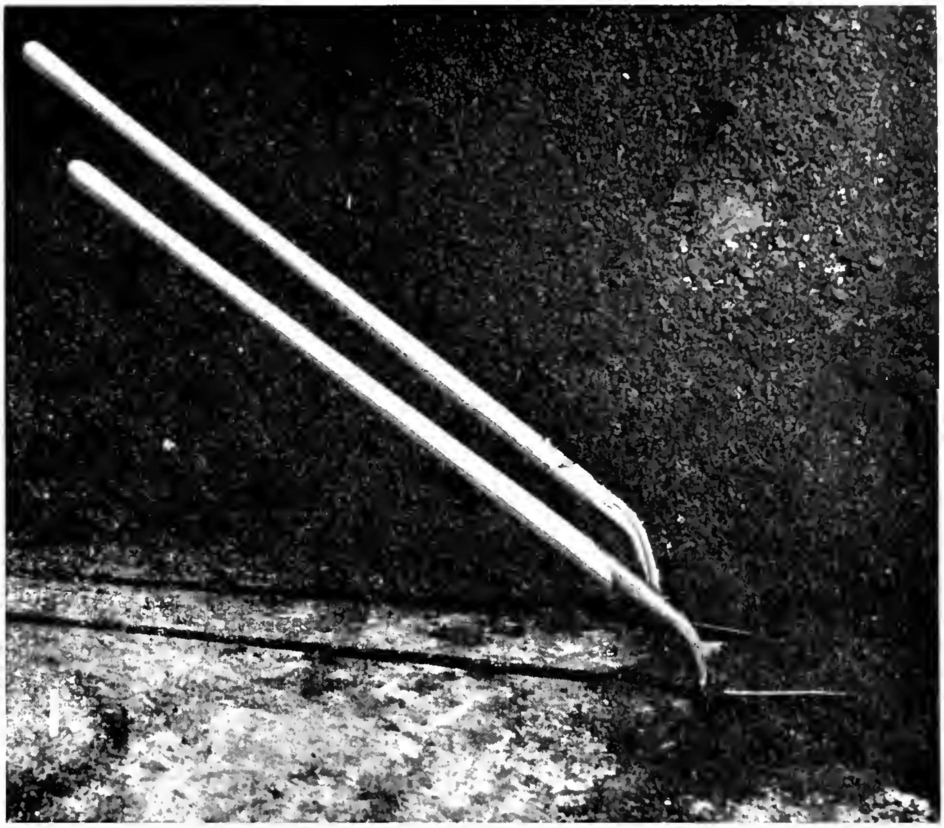
Comparison of Shovels

In *Figure 1*, the shovel in the foreground came closest to the preferred

type and except for the lift and length of handle would be satisfactory.

Figure 2 shows the same two shovels. For comparative purposes the same man was used in the illustrations. Note that the hand is higher in the left photograph requiring a lesser amount of stooping. The left hand is in a better position to force the shovel into the stockpile. Mechanical principles of the human body are the same as any other machine. Decreasing the number of movements tends to increase the life of the machine, as well as increase the efficiency.

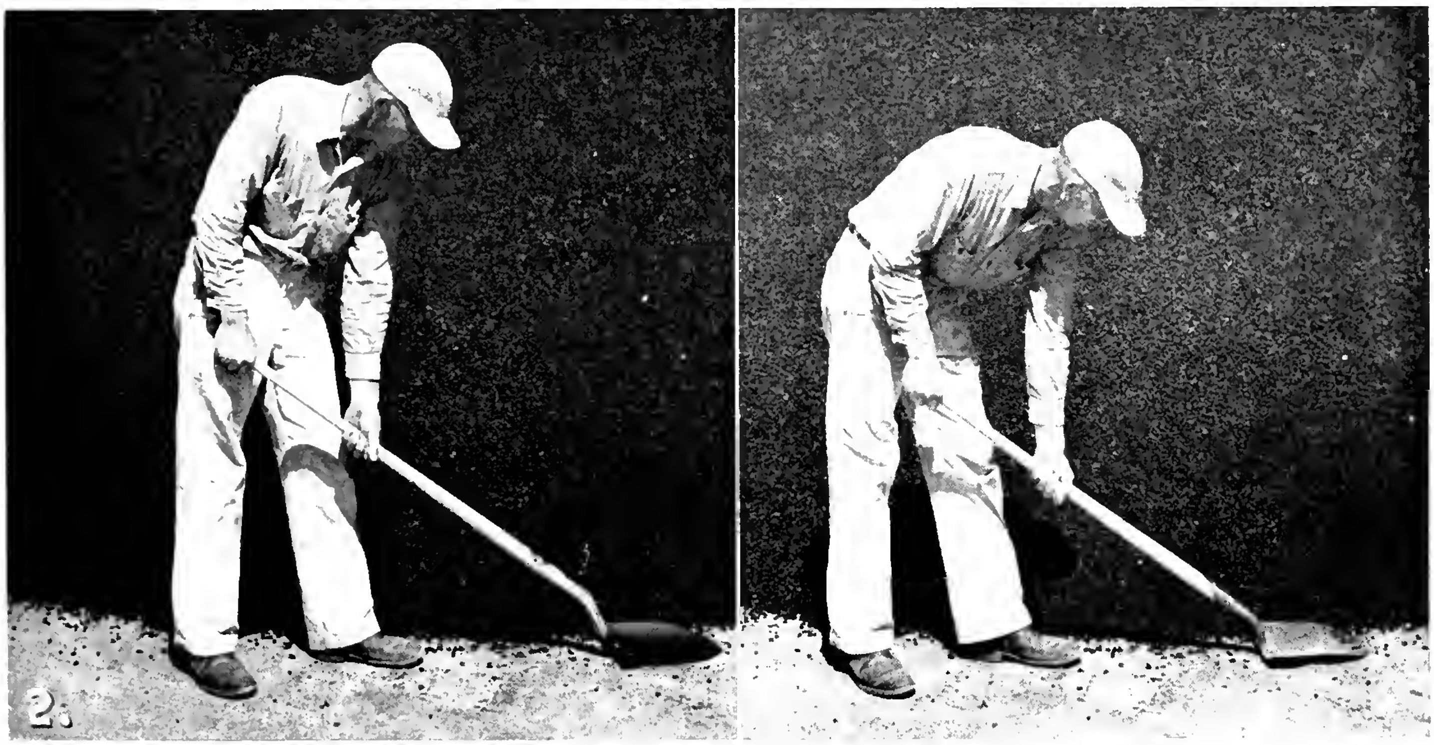
The lift is measured by placing the blade of the shovel on a flat surface and observing the vertical distance to the tip of the handle. The shovel in the background was fabricated to our specifications. It is obvious that the bend at the shank is similar and the additional lift is accomplished with the longer handle. The natural angle of repose of the handles is identical.



Commercial shovel in foreground and California highway shovel in background, showing difference in lift and length

The questionnaire indicated the following major objections to the test shovels: 1. Too heavy. 2. Handle too short. 3. Handle too large in diameter. 4. Insufficient lift. 5. Poor balance. With these objections in mind, and by making physical measurements of the shovel parts which the men considered satisfactory, a composite of the desirable features indicated the final design.

Same shovels as illustrated in Figure 1. Note the much better posture of the man with the highway shovel in the left picture



Paragraph (a) *General* of our specifications cover this composite.

Shape of Handle

Table I of the specifications covers the shape of the handle. It was first determined by inquiry whether it was practical to commercially manufacture a handle to the tolerances indicated. It was quite obvious from the questionnaire which handles had an acceptable shape and such handles were calipered and plotted graphically. A mean line was drawn for the group and the maximum deviation from the mean was accepted as the allowable tolerance. The diameter in inches, as shown in the table, is a composite of 15 different shovels of various grades made by several different manufacturers. It was noted that a well shaped handle often made an inferior quality shovel more acceptable to the user than one of better quality with a clumsy or cumbersome handle.

After a thorough examination of the test shovels, it was definitely apparent that there would be no economy in procuring a shovel produced from anything but the best materials. Handles made of inferior grades of wood were broken along the slash grain, splintered and badly checked while those of first grade ash were still in excellent condition. The steel of the lower grade shovels showed two definite weaknesses. Some were extremely hard and fairly abrasive resistant but did not have sufficient ductility to stand the constant bending and failed by cracking. Some of the steel was so soft that it was only a short time before they were so badly worn they were no longer usable.

Best Grade of Ash

Manufacturers were consulted and they were all of the opinion that in our type of work, it was false economy to use anything but the best grade of ash obtainable for the handles and an alloy steel for the blades. They agreed that the steel should be both abrasive resistant and relatively ductile when properly heat treated.

It was interesting to note the workmanship in the lower grade shovels which were tested. A heavy coat of paint over rivets, welds and other joints greatly enhanced the tools' appearance. This "camouflage" was soon obvious after the shovels were put to work—without exception the ones which were painted the prettiest were the ones relegated to the junk pile first. Our specifications were written to eliminate as much "camouflage" as possible.

In addition to the test requirements of the present specifications, we will soon be able to include a fatigue test. The Division of Highways Materials and Research Department is working with the Stores Department on a laboratory test designed to simulate field conditions. The test will specify the number of flexures a shovel must withstand under fixed conditions without any apparent failure. Failures occurring in the handle or blade will be classed as material failures. Failures occurring at welds or riveted joints will be classed as fabication failures. Present indications are that a test may be devised which will simulate field conditions in the laboratory and give a fast check on both materials and quality of workmanship.

Results indicate that when repeated stresses are applied, failure will occur in a definite pattern depending upon the quality of the shovel. Shovels of comparable grades fail at approximately the same number of cycles. From these observations, it is believed that the severity of the test can be made such that any shovel can be graded by the number of cycles necessary to accomplish failure. Our specifications will be based on the number of cycles necessary to cause failure of the best grade of chromium molybdenum shovels available commercially.

To our knowledge there is no commercial stock shovel available which will meet all provisions of our specification. Apparently shovel manufacturers have spent a great deal of time designing shovels for general use, and many special uses. However, they have never considered specifically the type of work being done by highway maintenance forces. From all reports, the shovels manufactured under the following specifications are proving to be far more satisfactory to the users than any stock shovels we have been able to procure in the past.

The highway workers who actually use these shovels wrote the specifications by telling the Stores Department engineers what they wanted. As a result of this cooperation the Stores Department has been able to procure shovels which will give much more wear for each dollar of cost. Being a lighter and better balanced tool, it will increase the efficiency of the men employed on highway maintenance work by requiring less energy to accomplish their shoveling tasks.

Robert M. Shillito Named Assistant To Public Works Chief

DIRECTOR of Public Works C. H. Purcell has appointed as his special assistant Robert M. Shillito, of San Francisco, who resigned as Director of the Highways and Transportation Department of the California State Chamber of Commerce to accept the job, which is exempt from civil service.

Purcell said that the position of Deputy Director of Public Works, which previously had been the exempt appointment in the department, has been reestablished as a civil service post and that with the approval of the State Personnel Board he has named Frank B. Durkee to the permanent position of Deputy Director. Durkee has been holding that office exempt from civil service since May, 1948.

Shillito is a graduate of the University of California at Los Angeles. During the war served in the South Pacific and Pacific Theaters as aircraft maintenance engineering officer with the 403 Troop Carrier Group of the 13th Air Force. In 1946, he was employed as Director of Public Relations for the Southern California Council of the California State Chamber of Commerce, with headquarters in Los Angeles. Subsequently he was Assistant Manager of the Southern California Council until 1948 when he became Director of the State Chamber's Transportation and Highway Department in San Francisco.

Shillito is married to the former Elizabeth Despard Kinne of Los Angeles. He will make his home in Sacramento.

CALIFORNIA DIVISION OF HIGHWAYS SPECIFICATIONS FOR LONG-HANDLED SHOVELS

(a) General.—Shovels supplied under these specifications shall be of the type known to the industry as "smooth, plain back."

The weight of round point shovels shall not exceed fifty-two (52) pounds per dozen and the weight of square point shovels shall not exceed fifty-four (54) pounds per dozen.

The length from tip of blade to the end of the handle shall be not less than 59½ inches nor more than 60½ inches.

The blades of the round point shovels shall be not less than 8¾ inches wide and not more than 9 inches wide, and the length shall be not less than 11½ inches and not more than 12 inches. The width of the blades of the square point shovel shall be not less than 9¼ inches and not more than 9½ inches, and the length shall be not less than 11½ inches and not more than 12 inches.

The shape of the handle shall conform to the dimensions shown on Table I, which table is hereby referred to and made a part of these specifications.

The finish of the blade shall be black or natural and shall be coated with a suitable material to prevent rust while in storage. The strap shall be polished and coated with a suitable material to prevent rust while in storage. The handle shall be sanded and waxed only. No painting or other finish on the handle will be acceptable.

The lift of the shovels shall be not less than 35 inches nor more than 37 inches at the end of the handle. The lift will be measured by clamping the center of the blade to a plane surface at a point two inches from the leading edge of the blade. The vertical distance from that plane surface to the center of the end of the handle shall be the lift. The lift will be based on a shovel measuring 60 inches from the tip of the blade to the end of the handle. The center axis of the blade shall be flat for at least seven inches from the point.

Either plain step or rolled step shovels shall be furnished under these specifications as called for on the purchase order.

(b) Materials.—The blade shall be fabricated from 16 gauge sheets of suitable alloy steel. A suitable alloy steel shall be considered as one which has physical characteristics similar to chromium molybdenum steel (A. I. S. I. 4140) or nickel-molybdenum steel properly heat treated to meet the hardness and flexure requirements as set forth in Article (c) Tests, herein. Bidders shall submit chemical analysis of proposed alloy steel to be used. The State reserves the right to reject any bids of alloy steels they feel are not comparable to those listed above.

The handle shall be seasoned ash, Grade SA, as specified in the National Bureau of Standards, Simplified Practice Recommendations R 76-40.

(c) Tests.—The Rockwell Number indicating the hardness of the blade shall be not less than 45C nor more than 50C.

With the lower two inches of the blade of a round point shovel held firmly gripped in a vise, with the face out and up, and the blade bent by forcing the handle to move in a forward and downward direction through an arc of seventy-five degrees (75°) three successive times; the blade shall show no signs of cracking or permanent deformation. The steel used in square point shovels shall be of the same heat or chemical analysis, and shall be heat treated in the same manner as the round point.

(d) Construction.—All welds shall be polished to the approximate plane of the blade plate.

The cutting edges shall be sharpened or beveled in accordance with commercial practice. The cutting edges of round point shovels shall be considered as the bottom half of the blade. All exposed metal edges, except the cutting edges of the blade shall be smooth. Rough or raw edges will not be tolerated.

Shank straps shall be flush with the handle and polished.

Rivets shall be countersunk, smoothly finished and polished.

The abbreviation "CAL. DIV. HWYS." shall be branded on the side of the handle between the straps in letters one-quarter inch high. No markings within 34 inches of the end of the handle or on the top or bottom of the shank of the handle will be permitted. This provision does not prohibit the placing of gummed labels on the shanks.

Table 1—Shape of Handle

(Referred to in Article (a) General.)

Distance in inches from end of handle	*Diameter in inches*	*Tolerance*
2	1-9/32	± 1/32
4	1-1/8	
6	1-1/32	
12	1-1/32	
16	1-1/16	± 1/16
20	1-5/32	
24	1-1/4	
30	1-3/8	
34	1-7/16	
Shank	1-7/16	

Division of Highways Bowling Team Again Is Championship Winner

"Winner, and still champion" for the second successive year, of the State Employees Bowling League is the Division of Highways team.

Last year the team got off to a slow start but climbed steadily all season to win. This year it was in the first division at all times, but still did not clinch the championship until the final match.

Charlie Nassi of the Highway Division is captain of the winning team.

Other members are: Larry Kime, Division of Highways, Al Strubinger and Stan Havlik, Division of Architecture, and Warren Marsden, Division of Contracts and Rights of Way.

Out of the Mail Bag

FINDS MAGAZINE VALUABLE

SAN MATEO, CALIFORNIA

California Highways and Public Works
Sacramento, California

GENTLEMEN: Please send me if possible a copy of *California Highways and Public Works*—the issue of November-December, 1949.

I will appreciate it greatly if you will send me this issue as it is the only one missing from my more than five years' collection.

I have learned more from your magazine and its contributors than I have learned in 35 years of paving experience.

Mail it COD or any other way and I will be very glad to pay for it.

A lawyer borrowed the missing copy to peruse the subject of contracts, decisions, etc., and lost it.

Yours very truly,
U. A. BROWN

PRAISE FOR AL SHIRA

MOORPARK CHAMBER OF COMMERCE
P. O. Box 462
Moorpark, California

MR. CHARLES H. PURCELL
Director of Public Works
Sacramento, California

DEAR MR. PURCELL: We have had numerous problems here in the Simi Valley which have been handled effectively by the division foreman in this area, and we of the Moorpark Chamber of Commerce agree unanimously that the improvements made on the Santa Susana Grade is a good example of one of these problems solved.

It has been our observation that your division foreman, Al Shira, did a worthy job in managing both men and equipment with a maximum of efficiency.

I'm sure the people here in the Simi Valley as well as anyone driving the Santa Susana Grade does so with a greater sense of security that was missing prior to the work just completed.

The members of the Moorpark Chamber of Commerce sincerely appreciate your local organization and its men.

Very truly yours,
MELBA BILLINGSLEY, *Secretary*
Moorpark Chamber of Commerce

Highway Bids and Awards for January, February, March, and April, 1950

January, 1950

ALAMEDA COUNTY—Furnishing and installing traffic signals and highway lighting at the intersection of MacArthur Boulevard with Foothill Boulevard and 73d Avenue in the City of Oakland. District IV, Route 5. Scott Buttner Electric Co., Inc., Oakland, $14,535. Spott Electrical Co., Oakland, $14,650; Abbett Electric Corp., Emeryville, $15,237; Del Monte Electric Co., Oakland, $15,316. Contract awarded to L. H. Leonardi Electrical Construction Co., San Rafael, $13,169.

ALAMEDA COUNTY—Across San Leandro Creek and the tracks of the Southern Pacific Company at the south city limits of Oakland, a steel girder bridge to be constructed. District IV, Route 69. Fredrickson Bros., Emeryville, $697,790; Carl N. Swenson Co., Inc., San Jose, $705,610; Erickson, Phillips & Weisberg, Oakland, $706,917; Bates & Rogers Construction Corp., San Francisco, $707,626; Frederickson & Watson Construction Co., Oakland, $707,778; J. H. Pomeroy & Co., Inc., San Francisco, $709,695; Underground Construction Co., Oakland, $710,534. H. W. Ruby, Sacramento, $713,394; Charles MacClosky Co., San Francisco, $716,843; Granite Construction Co., Watsonville, $716,863; Johnson, Drake & Piper, Inc., Oakland, $718,491; A. Soda & Son, Oakland, $723,595; Dan Caputo and Edward Keeble, San Jose, $732,419; Stolte, Inc., and The Duncanson-Harrelson Co., Oakland, $736,852; Guy F. Atkinson Co., South San Francisco, $739,907; Lew Jones Construction Co., Inc., and Brighton Sand & Gravel Co., San Jose, $748,039; Healy, Tibbitts Construction Co., San Francisco, $773,682; S. J. Amoroso Construction Co., San Francisco, $781,152. Contract awarded to C. B. Tuttle Co., Long Beach, $680,741.

IMPERIAL COUNTY—Across Rockwood Canal, about 2.5 miles south of Brawley, a reinforced concrete slab bridge to be constructed and about 0.4 mile to be graded and surfaced with road-mixed surfacing on imported base material. District XI, Route 201, Section B. Hubbs Equipment Co., Colton, $28,960; Roland T. Reynolds and Thomas Construction Co., Burbank, $30,067; E. C. Young & Co., San Fernando, $30,727. Contract awarded to Arthur A. Johnson, Laguna Beach, $24,443.

LOS ANGELES COUNTY—On Santa Ana Parkway, between Rosecrans Avenue and Orange county line, about 3.5 miles, a new two-lane roadway parallel to the existing roadway to be graded and paved with asphalt concrete on cement treated base and outer highways to be graded and surfaced with plant-mixed surfacing on untreated rock base, to provide a four lane divided highway with outer highways on each side. The existing bridge over Coyote Creek is to be extended and three new reinforced concrete slab bridges are to be constructed parallel to the existing bridge. District VII, Route 174, Section B. Griffith Co., Los Angeles, $695,911; Basich Bros. Construction Co. and Basich Bros., San Gabriel, $719,829; Sully Miller Contracting Co., Long Beach, $730,649; Spencer Webb Co., Los Angeles, $736,531; Chas. MacClosky Co. and Clyde W. Wood, Inc., North Hollywood, $760,378; Cox Bros. Construction Co. and J. E. Haddock, Ltd., Pasadena, $786,551; N. M. Ball Sons, Berkeley, $791,293; Dimmitt & Taylor and K. B. Nicholas, Monrovia, $806,677; C. O. Sparks, Inc., and Mundo Engineering Co., Los Angeles, $832,956; Tomei Construction Co., Van Nuys, $845,765. Contract awarded to Peter Kiewit Sons Co., Arcadia, $677,249.

LOS ANGELES COUNTY—On Firestone Boulevard from Rosecrans Avenue to Valley View Avenue, furnish and install highway lighting at two intersections, furnish and install full traffic actuated signal systems and highway lighting at two intersections. District VII, Route 174, Section B. Electric & Machinery Service, Inc., South Gate, $23,962; Westates Electrical Construction Co., Los Angeles, $24,018; Clinton Electrical Corp., Los Angeles, $25,432. Contract awarded to C. D. Draucker, Inc., Los Angeles, $23,746.

MARIN COUNTY—Constructing two car garage at bridge tenders' residences at Black Point. District IV, Route 8, Section A. R. Taylor Willis, Santa Rosa, $2,932; Parish Bros., Benicia, $3,199; G. O. Millie Construction Co., San Rafael, $3,740; W. J. Kubon, San Rafael, $3,944; Jensen and Pitts, San Rafael, $5,240. Contract awarded to Herman Krusi, Berkeley, $2,795.

NAPA COUNTY—Between Foster Road and Union Station about 3.1 miles to be graded and surfaced with plant-mixed surfacing on crusher-run base. District IV, Routes 8, 49, Sections A, D, Nap, B. Rice Bros., Marysville, $239,917; C. M. Syar, Vallejo, $240,056; Parish Bros., Benicia, $257,448; Granite Construction Co., Watsonville, $258,822; Munn & Perkins, Modesto, $265,038; A. G. Raisch Co., San Rafael, $267,852; Eugene G. Alves, Pittsburg, $268,372; Lee J. Immel, San Pablo, $274,347; J. R. Armstrong, El Cerrito, $276,242; Harms Bros., Sacramento, $283,150; Chittenden & Chittenden, Auburn, $283,683; Brown Ely Co. Contractors and E. A. Forde, Corte Madera, $287,007; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $288,779; A. Teichert & Son, Inc., Sacramento, $288,798; J. Henry Harris, Berkeley, $297,522; McGillivray Constuction Co., Sacamento, $315,968. Contract awarded to Fredrickson Bros., Emeryville, $239,505.

SANTA CRUZ COUNTY—Furnishing and installing traffic signal system at the intersection of Santa Cruz-Watsonville Freeway with Morrissey Avenue-Pacheco Avenue in the City of Santa Cruz. District IV, Route 56. Granite Construction Co., Watsonville, $11,097. Contract awarded to L. H. Leonardi Electrical Construction Co., San Rafael, $8,935.

SAN MATEO COUNTY—On El Camino Real, between Whipple Avenue and Woodside Road in Redwood City, furnishing and installing traffic signal systems and highway lighting. District IV, Route 2. Manning & Whitaker, Inc., San Francisco, $35,642; Spott Electrical Co., Oakland, $39,949; Abbett Electric Corp., San Francisco, $44,484; Granite Construction Co., Watsonville, $46,145; H. S. Tittle Co., San Francisco, $47,827. Contract awarded to L. H. Leonardi Electrical Construction Co., San Rafael, $29,999.

SAN MATEO COUNTY—Between Frenchman's Creek and 1.0 mile northerly, about 1.0 mile to be graded and surfaced with plant-mixed surfacing on imported base material. District IV, Route 56, Section C. A. Teichert & Son, Inc., Sacramento, $97,323; Louis Biasotti & Son, Stockton, $99,004; Nevada Constructors, Inc., Reno, $109,240; Granite Construction Co., Watsonville, $111,025; Elmer J. Warner, Stockton, $114,754; L. C. Smith, San Mateo, $133,826; Peter Sorensen, Redwood City, $137,852. Contract awarded to Eugene G. Alves, Pittsburg, $82,916.

VENTURA COUNTY—On Oxnard Boulevard, between north city limits and south city limits of Oxnard, about 1.9 miles to be graded and paved with asphalt concrete on cement treated base and existing pavement. District VII, Route 60. J. E. Haddock, Ltd., Pasadena, $259,536; Granite Construction Co., Watsonville, $263,439; Griffith Co., Los Angeles, $263,746; Clyde W. Wood, Inc., North Hollywood, $264,508; Hensler Construction Corp., Glendale, $268,263; Frank T. Hickey, Inc., Los Angeles, $280,865. Contract awarded to Baker & Pollock, Ventura, $259,445.

VENTURA COUNTY—At the foot of Fir Street in the City of Ventura, the existing Ventura Pier to be repaired. Ventura Beach State Park. District VII. E. G. Perham, Los Angeles, $26,543; Pugh Construction Corp., San Pedro, $27,051; E. L. Thorsten, Santa Monica, $28,166; C. J. B. Construction Co., Oxnard, $30,377; Macco Corp., Paramount, $33,475; Shannahan, Inc., Los Angeles, $43,640; N. M. Saliba Co., Los Angeles, $63,801. Contract awarded to C. B. Tuttle Co., Long Beach, $23,753.

F. A. S. County Projects

MONO COUNTY—Between 4.2 miles and 0.4 mile west of U. S. Route 395, about six miles north of Coleville, about 3.6 miles to be graded. District IX, Route 959. Huntington Bros., San Anselmo, $91,128; M. W. Brown, Redding, $107,861; Arthur A. Johnson, Laguna Beach, $107,977; George Pollock Co., Sacramento, $110,225; Mathews Construction Co., Alhambra, $110,574; Clyde W. Wood, Inc., North Hollywood, $119,133; Bishop Engineering and Construction Co., Bishop, $127,319; Anderson Company, Visalia, $139,774; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $165,734; Chittenden & Chittenden, Auburn, $227,628. Contract awarded to Westbrook & Pope, Sacramento, $88,051.

LOS ANGELES COUNTY—Across San Gabriel River on Florence Avenue, a reinforced concrete girder bridge to be constructed. District VII, Route 838. Lars Oberg, Los Angeles, $219,751; E. G. Perham, Los Angeles, $226,223; Byerts & Sons, Los Angeles, $227,591; Griffith Company, Los Angeles, $229,515; K. B. Nicholas, Ontario, $232,200; Gardner & McCall, Long Beach, $234,035; Charles MacClosky Co., San Francisco, $238,829; Sharp & Fellows Contracting Co., Los Angeles, $239,475; C. B. Tuttle Co., Long Beach, $239,820; Granite Construction Co., Watsonville, $241,227; W. J. Disteli, Los Angeles, $243,597; J. E. Haddock, Ltd., Pasadena, $243,722; Guy F. Atkinson Co., Long Beach, $243,893; N. M. Saliba Co., Los Angeles, $249,004; Anderson Company, Visalia, $259,758; Ralph A. Bell, Monrovia, $262,983; Spencer Webb Co., Los Angeles, $265,336; Carlo Bongiovanni Construction Co., Hollywood, $278,494. Contract awarded to Davies, Keusder & Brown, Los Angeles, $214,916.

February, 1950

KINGS COUNTY—At junction of Routes 10 and 135 at the east city limits of Hanford, furnish and install traffic signal and lighting system. District VI, Routes 10 and 135, Section, Han,A,A. Clinton Electric Corp., Los Angeles, $9,565; L. H. Leonardi Electric Construction Co., San Rafael, $10,281; R. O. Ferguson Company, Visalia, $10,919. Contract awarded to Westates Electrical Construction Co., Los Angeles, $8,578.

LOS ANGELES COUNTY—Over Hollywood Freeway and outlet ramp, at Hill Street in the City of Los Angeles, a reinforced concrete box girder bridge for an overcrossing to be constructed. District VII, Route 2. Guy F. Atkinson Co., Long Beach, $396,208; Chas. MacClosky Co., San Francisco, $410,843; Erickson, Phillips & Weisberg, Oakland, $412,838; Chas. J. Rounds & Lars Oberg Contractor, Los Angeles, $422,799; C. B. Tuttle Co., Long Beach, $422,805; W. J. Disteli & R. J. Daum Construction Co., Los Angeles, $427,912; J. E. Haddock, Ltd., Pasadena, $437,750; Frank T. Hickey, Inc. & Byerts & Sons, Los Angeles, $447,266; Griffith Co., Los Angeles, $460,861; Oberg Bros. Construction Co., Inglewood, $471,802; Carlo Bongiovanni Construction Co., Hollywood, $476,769; Norman I Fadel, North Hollywood, $524,936. Contract awarded to Spencer Webb Co., Los Angeles, $377,131.

LOS ANGELES COUNTY—Between 0.4 miles south of Castaic Creek and 0.4 mile north of Palomas Wash, about 5.1 miles to be graded and surfaced with plant mixed surfacing on cement treated base, and two reinforced concrete bridges to be constructed. District VII, Route 4, Section A. G. Parish Bros., Benicia, $793,607; Fredrickson Bros., Emeryville, $799,560; N. M. Ball Sons, Berkeley, $843,435; Hensler Construction Corp., Glendale, $856,016; Claude Fisher Co., Ltd., Los Angeles, $857,906; Griffith Co., Los Angeles, $868,579; Yount Constructors Inc. & Winston Bros. Co., Azusa, $872,669; Rand Construction Co. Inc., Bakersfield, $879,497; L. A. & R. S. Crow, El Monte, $888,194; Clyde W. Wood, Inc., North Hollywood, $891,266; Oilfields Trucking Co. & Phoenix Construction Co. Inc., Bakersfield, $897,392; Peter Kiewit Sons Co., Arcadia, $903,986; Cox Bros. Construction Co. & J. E. Haddock, Ltd., Pasadena, $920,639; A. Teichert & Son, Inc., Sacramento, $928,228; Granite Construction Co., Watsonville, $928,632; Dimmit & Taylor & K. B. Nicholas, Monrovia, $939,643; Ralph A. Bell, Mon-

rovia, $966,804; M. J. B. Construction Co., Stockton, $970,453; Silva & Hill Construction Co., & G. W. Ellis Construction Co., Los Angeles, $982,504. Contract awarded to Basich Bros. & Basich Bros. Construction Co. & W. C. Lefever & D. Gerald Bing, San Gabriel, $793,305.80.

ORANGE COUNTY—Between south city limits of Newport Beach and Myrtle Avenue in Laguna Beach, about 5.5 miles to be widened and surfaced with plant mixed surfacing on untreated rock base and on the existing pavement. District VII, Route 60, Section B, Lgn B. Sully-Miller Contracting Co., Long Beach, $362,705; Griffith Co., Los Angeles, $368,226; John J. Swigart Co., Torrance, $368,716; Cox Bros. Construction Co., Stanton, $377,790; Arthur A. Johnson, Laguna Beach, $384,362; Matich Bros., Colton, $401,020. Contract awarded to Hensler Construction Corp., Glendale, $345,505.

LOS ANGELES COUNTY—On Ramona Freeway between Macy Street and Helen Drive, highway lighting and illuminated sign systems to be furnished and installed. District VII, Route 26, Section L.A.D. Ets-Hokin & Galvan, Wilmington, $35,881; Newberry Electric Corp., Los Angeles, $36,465. Contract awarded to Electric & Machinery Service, Inc., South Gate, $35,664.

SAN DIEGO COUNTY—Metal guide posts and culvert markers. District XI, Route 2. R. E. Hazard Contracting Co., San Diego, $16,391; Griffith Co., Los Angeles, $16,659. Contract awarded to V. R. Dennis Construction Co., San Diego, $14,953.25.

SAN BERNARDINO COUNTY—One-half mile west of the Ontario city limit at the intersection of Holt Avenue and Central Avenue, furnish and install full traffic actuated signal and highway intersection lighting system. District VIII, Route 26, Section C. Paul R. Gardner, Ontario, $8,613; Westates Electrical Construction Co., Los Angeles, $8,904; C. D. Draucker Inc., Los Angeles, $8,732. Contract awarded to Clinton Electric Corp., Los Angeles, $8,463.

SAN BERNARDINO COUNTY—At Wheaton Wash Maintenance Station, about 36 miles east of Baker, a metal fence to be constructed. District VIII, Route 31, Section P. Los Angeles Fencing Co. Inc., Los Angeles, $3,255; Alcorn Fence Co., Los Angeles, $3,394. Contract awarded to American Steel & Wire Co. of New Jersey (Cyclone Fence Div.), Glendale, $3,177.

VENTURA COUNTY—In the City of Oxnard at the intersection of Oxnard Boulevard with Saviers Road-Wooley Road, traffic signal system and intersection lighting to be furnished and installed. District VII, Route 60. Electric & Machinery Service, Inc., South Gate, $11,992; C. D. Draucker, Inc., Los Angeles, $12,718; Paul R. Gardner, Ontario, $12,953; C.J.D. Construction Co., Oxnard, $13,766. Contract awarded to Westates Electrical Construction Co., Los Angeles, $11,937.

YOLO COUNTY—On the Yolo Causeway, furnish and install highway lighting system. District III, Route 6, Section B. Del Monte Electric Co., Oakland, $31,942; Manning & Whitaker, Inc., San Francisco, $32,266; Collins Electrical Co., Stockton, $32,666; Wismer & Becker, Sacramento, $32,790; Reliable Elevator Works, Sacramento, $35,054; Abbett Electric Corp., Emeryville, $35,378; R. Goold & Son, Stockton, $36,720; Luppen & Hawley, Inc., Sacramento, $37,116; Karl F. Stolting, Santa Rosa, $37,185; Spott Electrical Co., Oakland, $41,456; Scott-Buttner Electric Co. Inc., Oakland, $47,985; Underground Electric Construction Co., Oakland, $52,335; L. H. Leonardi Electric Construction Co., San Rafael, $53,449. Contract awarded to Grason Electric Co., Sacramento, $29,749.

F. A. S. County Projects

KERN COUNTY—Brundage Lane, between Union Avenue and Fairfax Road, about four miles to be graded and surfaced with plant-mixed surfacing on untreated rock base. District VI, Route 575. Griffith Company, Los Angeles, $132,222; Rand Construction Co. Inc., Bakersfield, $133,949; Rice Brothers, Marysville, $179,884; Contract awarded to Oilfields Trucking Co. & Phoenix Construction Co. Inc., Bakersfield, $130,254.

TULARE COUNTY—On Lovers Lane, between State Route 134 and six miles north, about 6.0 miles to be graded and surfaced with road-mixed surfacing on cement treated imported base material. District VI, Route 1137. P. J. Moore & Son, North Sacramento, $132,104; Anderson Company, Visalia, $137,932; Oilfields Trucking Co. & Phoenix Construction Co. Inc., Bakersfield, $138,251; K & H Company, Colton, $141,534; Rice Bros., Inc., Marysville, $143,869; Rand Construction Co. Inc., Bakersfield, $144,115; Nevada Constructors, Inc., Reno, $146,534; Munn & Perkins, Modesto, $147,141; Gene Richards, Inc., Fresno, $148,000; Frank T. Hickey, Inc., Los Angeles, $151,993; Louis Biasotti & Son, Stockton, $153,361; Valley Paving & Construction Co., Inc., Pismo Beach, $159,316; Volpa Brothers, Fresno, $159,395; Griffith Company, Los Angeles, $163,328; George Pollock Co., Sacramento, $173,766; Covina Construction Co., Covina, $178,181; Halloran & Gill, Bakersfield, $179,909; Clyde W. Wood & Sons, Inc., North Hollywood, $182,442; Elmer J. Warner, Stockton, $185,985; Madonna Construction Co., San Luis Obispo, $199,852; Dicco, Inc. & Dix-Syl Construction Co. Inc., Bakersfield, $200,116. Contract awarded to George E. France, Inc., Visalia, $123,805.

GLENN COUNTY—Across Willow Creek about four miles west of State Route 45, an existing reinforced concrete bridge to be widened. District III, Route 1121. H. H. Anderson, San Leandro, $9,710; James H. McFarland, San Francisco, $10,758; Lord & Bishop, Sacramento, $10,993; O'Connor Bros., Red Bluff, $11,098; Gordon C. Weems, Willows, $11,470; Chittenden & Chittenden, Auburn, $11,868; Ted Schwartz, Smartville, $11,976; H. Earl Parker Inc., Marysville, $12,392; Louis Bormolini & Son, Novato, $12,728; J. P. Brennan, Redding, $12,780; C. O. Bodenhamer, Redwood City, $12,889; B. S. McElderry, Berkeley, $13,682. Contract awarded to Bos Construction Co., Oakland, $9,532.

March, 1950

ALAMEDA COUNTY—Across Vallecitos Creek about 9 miles southwest of Livermore, a bridge to be repaired. District IV, Route 108, Section A. Earl W. Heple, San Jose, $3,628; Bos Construction Co., Oakland, $3,761; Jas. H. McFarland, San Francisco, $3,886; O. C. Jones & Sons, Berkeley, $3,964; Dan Caputo, San Jose, $4,414; Herbert H. Anderson, San Leandro, $4,482; J. Henry Harris, Berkeley, $4,793; B. S. McElderry, Berkeley, $5,982. Contract awarded to Lew Jones Construction Co., San Jose, $3,409.

CONTRA COSTA COUNTY—Between Port Chicago Road and Pittsburg, about 4.5 miles to be graded and surfaced with plant-mixed surfacing on existing pavement and on cement treated base, a curbed central dividing strip and two reinforced concrete bridges to be constructed to provide a four-lane divided highway. District IV, Route 75, Section F. United Concrete Pipe Corp., Baldwin Park, $853,223.95; Fredrickson Bros., Emeryville, $871,123; Fredrickson & Watson Construction Co., Oakland, $880,806; Dan Caputo & Edward Keeble, San Jose, $912,457; Guy F. Atkinson Co., South San Francisco, $923,923; H. Earl Parker Inc. & N. M. Ball Sons, Berkeley, $965,564; Lord & Bishop & M. J. B. Construction Co., Sacramento, $992,865; Harms Bros., Sacramento, $1,036,426; Charles L. Harney, Inc., San Francisco, $1,244,866. Contract awarded to Parish Bros., Benicia, $815,811.25.

IMPERIAL COUNTY—In the City of Brawley at the intersections of Main Street with First Street and with Sixth Street, traffic signal systems and intersection lighting to be furnished and installed. District XI, Routes 26, 187. Ed Seymour, Long Beach, $11,828; Ets-Hokin & Galvan, San Diego, $12,098. Contract awarded to Westates Electrical Construction Co., Los Angeles, $11,432.

IMPERIAL COUNTY—Between two miles northwest of Niland and Riverside county line, about 21.8 miles to be graded and surfaced with road-mixed surfacing on imported base material. District XI, Route 187, Sections F, G. Dimmitt & Taylor, Monrovia, $420,783; Arthur A. Johnson, Laguna Beach, $421,146; Peter Kiewit Sons Co., Arcadia, $439,157; E. L. Yeager Co., Riverside, $449,697; Anderson Co., Visalia, $454,356; Cox Bros. Construction Co., Stanton, $454,549; Claude Fisher Co., Ltd., Los Angeles, $455,359; R. P. Shea Construction Co., Indio, $469,701; Clyde W. Wood & Sons, Inc., North Hollywood, $470,250; Basich Bros. Construction Co. & Basich Bros., San Gabriel, $475,578; R. T. Reynolds & Thomas Construction Co., Burbank, $501,930. Contract awarded to Hensler Construction Corp., Glendale, $388,296.

IMPERIAL COUNTY—Between Ash Canal and South Alamo Canal, a distance of about 0.6 mile to be graded and surfaced with road mixed surfacing on imported base material. District XI, Route 202, Section C. E. S. & N. S. Johnson, Fullerton, $28,772; E. C. Young & Co., Bakersfield, $29,828; Mathews Construction Co., Alhambra, $31,076; Claude Fisher Co., Ltd., Los Angeles, $35,722; Anderson Co., Visalia, $36,350; James L. Miller & Sons, Los Angeles, $38,282; Foster & McHarg, Riverside, $46,410. Contract awarded to Hubbs Equipment Co., Colton, $22,399.

LOS ANGELES COUNTY—At the intersection of Sierra Highway with 10th Street, furnish and install semi-traffic actuated signal system. District VII, Route 23, Section F. Westates Electrical Construction Co., Los Angeles, $5,180; Clinton Electric Corp., Los Angeles, $5,638; Paul R. Gardner, Ontario, $5,788; C. D. Draucker, Inc., Los Angeles, $5,964. Contract awarded to Electric & Machinery Service, Inc., South Gate, $4,980.

LOS ANGELES COUNTY—At the intersection of Valley Boulevard with Mountain View Road, furnish and install fixed time traffic signal system. District VII, Route 77, Section A. Westates Electrical Construction Co., Los Angeles, $2,097; Paul R. Gardner, Ontario, $2,256; C. D. Draucker, Inc., Los Angeles, $2,385. Contract awarded to Electric & Machinery Service, Inc., South Gate, $2,042.

ORANGE COUNTY—In the City of Tustin, at the intersection of D Street with Main Street, furnish and install full traffic actuated signal system and intersection lighting. District VII, Route 2. Westates Electrical Construction Co., Los Angeles, $8,496; Clinton Electric Corp., Los Angeles, $8,993; Paul R. Gardner, Ontario, $9,411; C. D. Draucker, Inc., Los Angeles, $9,643. Contract awarded to Electric & Machinery Service, Inc., South Gate, $8,305.

SAN BERNARDINO COUNTY—California Institution for Men at Chino, about 1.2 miles, roads within the institution grounds to be graded and surfaced with plant-mixed surfacing on imported base material. District VIII. R. A. Erwin, Colton, $20,228; Ralph J. Laird, La Verne, $20,267; Hubbs Equipment Co., Colton, $20,863; A. A. Edmondson, Glendale, $21,757; American Asphalt Paving Co., Monrovia, $21,869; George Herz & Co., San Bernardino, $22,235; Parker Engineering Co., Claremont, $23,800; John J. Swigart, Torrance, $23,975; Cox Bros. Construction Co., Stanton, $25,092; A. Teichert & Son, Inc., Sacramento, $25,130; Bonadiman-McCain, Inc., Los Angeles, $25,540; Boulder Construction Co., Van Nuys, $26,154; Dimmitt & Taylor, Monrovia, $26,593; Griffith Co., Los Angeles, $28,608. Contract awarded to Matich Bros., Colton, $18,714.

SAN JOAQUIN COUNTY—Between Mariposa Road and Calaveras River and at D Street, furnishing and installing highway lighting at seven intersections and two interchange areas. District X, Routes 4, 5, Sections E, Stkn, C, Stkn. R. O. Ferguson Co., Visalia, $21,487; Curtis Electric Co., Stockton, $22,178; Collins Electric Co., Stockton, $22,888; L. H. Leonardi Electric Construction Co., San Rafael, $22,987; Ets-Hokin & Galvin, Stockton, $25,479. Contract awarded to R. Goold & Son, Stockton, $20,985.

ORANGE COUNTY—On Santa Ana Freeway between 0.2 mile southeast of Euclid Avenue and State Highway Route 2 at Miraflores, about 2.9 miles, a new two lane roadway parallel to portions of the existing roadway to be graded and paved with asphalt concrete on cement treated base, the portion through Anaheim to be widened on both sides and paved with asphalt concrete on existing pavement and new cement treated base and outer highways to be graded and surfaced with plant mixed surfacing on untreated rock base, to provide a four-lane divided highway with outer highways. District VII, Route 174. John J. Swigart Co., Torrance, $312,200; Sully-Miller Contracting Co., Long Beach, $315,116; J. E. Haddock, Ltd., Pasadena, $332,772; Peter Kiewit Sons Co., Arcadia, $345,565; Basich Bros. Construction Co. & Basich Bros., San Gabriel, $358,555. Contract awarded to Griffith Co., Los Angeles, $308,228.

ORANGE COUNTY—On Santa Ana Freeway, between Los Angeles county line and 0.2 mile southeasterly of Euclid Avenue, about five miles in length, a new two-lane roadway to be graded and surfaced with asphalt concrete on cement treated

base, portions of the existing pavement to be resurfaced with asphalt concrete; shoulders to be constructed of untreated rock surfacing and bituminous surface treatment applied thereto; and outer highways to be constructed to provide a four-lane divided highway. District VII, Route 174, Section A. Griffith Co., Los Angeles, $488,040; Peter Kiewit Sons Co., Arcadia, $514,167; Cox Bros. Construction Co. & J. E. Haddock, Ltd., Pasadena, $516,891; Basich Bros. Construction Co. & Basich Bros., San Gabriel, $578,498. Contract awarded to Sully-Miller Contracting Co., Long Beach, $466,258.

SAN BERNARDINO COUNTY—At Wheaton Wash Maintenance Station, three cottages to be constructed. District VIII, Route 31, Section P. Contract awarded to The Mahoney Morrison Co., Sun Land, $25,000.

SAN BERNARDINO COUNTY—City of San Bernardino, between F Street and east city limits, about 1.8 miles in length, existing roadbed to be widened and resurfaced with plant mixed surfacing. District VIII, Route 190. Matich Bros., Colton, $126,116; R. A. Erwin, Colton, $138,646; E. L. Yeager Co., Riverside, $147,510. Contract awarded to George Herz & Co., San Bernardino, $121,545.

SAN LUIS OBISPO COUNTY—Between Route 125 and Kern county line, about 4.2 miles, plant-mixed surfacing to be placed over cement treated imported borrow and existing pavement. District V, Route 33, Section C. Valley Paving and Construction Co., Inc., Pismo Beach, $103,493; N. M. Ball Sons, Berkeley, $112,012; Rand Construction Co., Bakersfield, $112,049; Madonna Construction Co., San Luis Obispo, $121,876. Contract awarded to Granite Construction Co., Watsonville, $98,457.

SANTA CLARA COUNTY—On Bayshore Highway at North First Street, a full traffic actuated signal system and highway lighting to be furnished and installed and channelization to be constructed. District IV, Route 68, Section B, SJs. J. C. Bateman, Inc., San Jose, $28,047; A. J. Raisch Paving Co., San Jose, $30,601; Granite Construction Co., Watsonville, $31,251; Leo F. Piazza, San Jose, $33,345. Contract awarded to Dan Caputo, San Jose, $27,590.

SOLANO COUNTY—At Fairfield Maintenance Station about three-fourths mile west of Fairfield, a prefabricated metal truck shed to be constructed. District X, Route 7, Section B. Da Roza Ribal, Inc., Monterey, $13,978; E. & G. Construction Co., Rio Vista, $14,600; J. A. Waterbury Construction Co., Inc., Sacramento, $16,190; O'Connor Bros., Red Bluff, $16,995; J. A. Bryant, Vallejo, $19,052; Cannon Construction Co., Stockton, $21,679. Contract awarded to E. J. Solomon, San Andreas, $13,075.

TULARE COUNTY—Between Visalia and Venida Substation, about 8.1 miles to be surfaced with plant-mixed surfacing and seal coat applied. District VI, Route 10, Section Vis., C. G. W. Ellis Construction Co., North Hollywood, $103,700; Valley Paving and Construction Co., Inc., Pismo Beach, $104,825; Gene Richards, Inc., Fresno, $107,326; N. M. Ball Sons, Berkeley, $110,161; Rand Construction Co., Bakersfield, $107,305; Guy F. Atkinson Co., South San Francisco, $112,036; Peter Kiewit Sons' Co., Arcadia, $113,412; M. J. Ruddy & Son, Modesto, $123,440; Rice Bros., Inc., Marysville, $124,987. Contract awarded to Griffith Co., Los Angeles, $97,530.

April, 1950

AMADOR COUNTY—Between the north city limits and the south city limits of Plymouth, about 0.9 mile in length, existing shoulders to be excavated and imported base material to be placed over shoulders and existing surfacing and surfaced with road-mixed surfacing. District X, Route 65. Claude C. Wood Co., Lodi, $18,411; Beerman & Jones, Sonora, $20,188; Browne & Krull, Hayward, $20,448; Louis Biasotti & Son, Stockton, $20,990; Miles & Bailey, Madera, $21,679; Paul L. Woof, Fresno, $22,230; Eugene G. Alves, Pittsburg, $22,769; C. M. Syar, Vallejo, $22,993; A. Teichert & Son, Inc., Sacramento, $23,687; O'Connor Bros., Red Bluff, $24,247; J. Henry Harris, Berkeley, $26,804; Harms Bros., Sacramento, $27,017; Tyson & Watters, Inc., Sacramento, $29,339; Brighton Sand & Gravel Co., Sacramento, $38,930. Contract awarded to P. S. Moore & Son, North Sacramento, $16,396.

BUTTE COUNTY—Between Chico and Tehama county line, portions, existing structures to be extended and roadbed to be widened. District III, Route 3, Section D. Wm. L. Thomas Construction Co., Sacramento, $30,967; C. O. Bodenhamer, Redwood City, $33,084; O'Connor Bros., Red Bluff, $37,631; Baker Trucking Co. & Gordon C. Weems, Hamilton City, $38,900; Liston Ehorn, Red Bluff, $39,752; Louis Bormolini & Son, Novato, $41,610; Robert Taylor, Oroville, $42,148; J. P. Brennan, Redding, $55,382. Contract awarded to Minton & Kubon, San Francisco, $27,361.

CONTRA COSTA COUNTY—In the City of Richmond, at Rost Drain, a reinforced concrete culvert to be constructed and a detour to be graded and surfaced and later obliterated. District IV, Route 69. J. R. Armstrong, El Cerrito, $30,496; J. Henry Harris, Berkeley, $32,913; Minton & Kubon, San Francisco, $32,991; B. S. McElderry, Berkeley, $41,632. Contract awarded to Lee & Immel, San Pablo, $28,817.

DEL NORTE COUNTY—Between Klamath River Bridge and Wilson Creek, about 6.7 miles to be surfaced with plant-mixed surfacing on cement treated base. District I, Route 1, Section A. Clements Co., Hayward, $252,600; N. M. Ball Sons, Berkeley, $255,348. Contract awarded to Harms Bros & C. M. Syar, Sacramento, $247,230.

DEL NORTE COUNTY—Between Smith River Bridge and one-fourth mile north of Winton Corners, about 4.7 miles to be graded and a two-span steel girder bridge with reinforced concrete deck to be constructed across Rowdy Creek. District I, Route 71, Sections A,B. Piombo Construction Co., San Francisco, $404,414; John Burman & Sons & G. M. Carr, Bati Rocca, Eureka, $415,248; Mercer Fraser Co., Inc., Mercer, Fraser Gas Co., Inc., J. L. Conner, Jr., Eureka, $419,920; Johnson Drake & Piper, Inc., Oakland, $489,887. Contract awarded to N. M. Ball Sons, Berkeley, $393,374.

GLENN AND BUTTE COUNTIES—At Big Butte Creek, about 6.50 miles east of Butte City, a bridge and approaches to be constructed. District III, Route 45, Sections C,A. M. A. Jenkins, Sacramento, $79,447; Fredrickson Bros., Emeryville, $80,351; Lew Jones Construction Co., San Jose, $81,007; Underground Construction Co., Oakland, $81,255; H. Earl Parker, Inc., Marysville, $82,543; R. G. Clifford, South San Francisco, $82,679; C. B. Tuttle Co., Long Beach, $83,068; Elmer J. Warner, Stockton, $85,184; E. H. Peterson & Son, Richmond, $85,391; E. G. Perham, Los Angeles, $87,175; Chittenden & Chittenden, Auburn, $89,031; O'Connor Bros., Red Bluff, $96,807; J. P. Brennan, Redding, $101,746. Contract awarded to Transocean Engineering Corp., San Lorenzo, $73,575.

HUMBOLDT COUNTY—Between one mile south of Orick and two miles south of Del Norte county line, about 5.2 miles to be surfaced with plant-mixed surfacing on cement treated base. District I, Route 1, Section K. Harms Bros. C. M. Syar, Sacramento, $202,812; N. M. Ball Sons, Berkeley, $211,502; Clements & Co., Hayward, $230,325; A. Teichert & Son, Inc., Sacramento, $232,030; Piombo Construction Co., San Francisco, $272,119. Contract awarded to Mercer, Fraser Co. & Mercer Fraser Gas Co., Inc., Eureka, $199,803.

IMPERIAL COUNTY—Across San Felipe Creek and overflow, about 2.5 miles east of San Diego county line, a reinforced concrete slab bridge to be constructed and about 0.5 mile of approaches and dip to be graded and bituminous surface treatment applied thereto, and drainage channels to be improved. District XI, Route 198, Section A. E. C. Young & Co., San Fernando, $103,255; Arthur A. Johnson, Laguna Beach, $105,341; Norman I. Fadel, North Hollywood, $107,580; Thomas Construction Co. & Roland T. Reynolds, Burbank, $107,787; E. G. Perham, Los Angeles, $107,963; Mathews Construction Co., Alhambra, $109,166; Bent Construction Co., Los Angeles, $109,870; C. B. Tuttle Co., Long Beach, $115,842; Walter H. Barber & H. R. Breeden, La Mesa, $117,266; Oberg & Cook, Gardena, $119,430; Claude Fisher Co., Ltd., Los Angeles, $121,038; L. S. & N. S. Johnson, Fullerton, $121,455; Foster & McHarg, Riverside, $122,637; Dimmitt & Taylor, Monrovia, $124,348; A. A. Edmondson, Glendale, $124,522; Byerts & Sons, Los Angeles, $135,069; Ralph A. Bell, Monrovia, $145,689. Contract awarded to Anderson Company, Visalia, $96,791.

KERN COUNTY—Between six miles west and two miles west of San Emidio Road, about 4 miles to be surfaced with road mixed surfacing. District VI, Route 57, Section B. Griffith Co., Los Angeles, $37,738; Oilfields Trucking Co. & Phoenix Construction Co., Inc., Bakersfield, $39,091; Halloran & Gill, Bakersfield, $40,078; California Fresno Asphalt Co., Fresno, $42,850; Louis Biasotti & Son, Stockton, $43,809; Browne & Krull, Hayward, $44,350; Rexroth & Rexroth, Bakersfield, $46,345; Valley Paving & Construction Co., Inc., Pismo Beach, $46,485; E. S. & N. S. Johnson, Fullerton, $48,625; Dicco, Inc., Bakersfield, $55,214; Covina Construction Co., Covina, $55,720. Contract awarded to Rand Construction Co., Inc., Bakersfield, $32,445.

KINGS COUNTY—Between 0.2 mile and 5.2 miles north of Kettleman City, about 5 miles in length, constructing a graded roadbed, placing imported borrow and imported base material and applying bituminous surface treatment and seal coats. District VI, Route 125, Section C. Anderson Co., Visalia, $108,141; P. J. Moore & Son, North Sacramento, $110,773; Volpa Bros., Fresno, $124,859; Munn & Perkins, Modesto, $125,049; Oilfield Trucking Co. & Phoenix Construction Co., Inc., Bakersfield, $125,448; Ted F. Baun, Fresno, $126,457; Rand Construction Co., Inc., Bakersfield, $130,457; Valley Paving & Construction Co., Inc., Pismo Beach, $133,280; Rice Bros., Inc., Marysville, $134,558; McGillivray Construction Co., Sacramento, $134,806; Griffith Co., Los Angeles, $136,084; Gene Richards, Inc., Fresno, $139,477; T. M. Page, Monrovia, $141,349; Claude Fisher Co., Inc., Los Angeles, $144,266; Roland T. Reynolds & Thomas Construction Co., Burbank, $145,264; N. M. Ball Sons, Berkeley, $167,968. Contract awarded to Westbrook & Pope, Sacramento, $98,468.

LAKE COUNTY—Between 0.4 mile west and 0.7 mile east of Tulelake, about 1.4 miles to be graded, road-mixed surfacing to be constructed on cement treated imported base material and seal coats to be applied. District I, Route 15, Section A. Eugene G. Alves, Pittsburg, $196,719; Piombo Construction Co., San Francisco, $196,804; John Burman & Sons, Eureka, $202,060; Fredrickson & Watson Construction Co., Oakland, $202,157; Arthur B. Siri, Inc., & Harold Smith, Santa Rosa, $211,218; F. E. Young & J. R. Armstrong, El Cerrito, $212,817; Harms Bros., Sacramento, $215,336; O'Connor Bros., Red Bluff, $222,759; Tyson & Watters, Inc., Sacramento, $231,406; Chittenden & Chittenden, Auburn, $233,945; Westbrook & Pope, Sacramento, $237,183; N. M. Ball Sons, Berkeley, $243,325. Contract awarded to M. W. Brown, Redding, $191,432.

LOS ANGELES COUNTY—On Sepulveda Boulevard, between Ohio Avenue and Bolas Street (portions) about 1.3 miles, to be graded, existing pavement to be widened with untreated rock base, and plant-mixed surfacing to be placed. District VII, Route 158, Sections A,L.A. Schroeder & Co., Sun Valley, $40,287; Griffith Company, Los Angeles, $42,170; M. S. Mecham & Sons, South Gate, $43,662; Oswald Bros. Co., Los Angeles, $45,479; Vernon Paving Co., Inc., Los Angeles, $46,639; A. A. Edmondson, Glendale, $51,687; Tomei Construction Co., Van Nuys, $53,055. Contract awarded to Jesse S. Smith, Glendale, $40,242.

LOS ANGELES COUNTY—Between Imperial Highway and Century Boulevard, about 1.1 miles, plant-mixed surfacing to be placed over existing pavement. District VII, Route 164, Section A. C. O. Sparks, Inc., & Mundo Engineering Co., Los Angeles, $40,333; Jesse S. Smith, Glendale, $42,458; M. S. Mecham & Sons, South Gate, $42,623; Griffith Co., Los Angeles, $44,013; Warren Southwest, Inc., Torrance, $45,022; Vido Kovacevich Co., South Gate, $45,175; Vernon Paving Co., Inc., Los Angeles, $45,690; Hensler Construction Corp., Glendale, $46,917. Contract awarded to Oswald Bros. Co., Los Angeles, $38,779.

LOS ANGELES COUNTY—On North Figueroa Street in the City of Los Angeles, between Marmion Way and Avenue 50 about 1.1 miles, existing pavement to be surfaced with plant-mixed surfacing. District VII, Route 165. Schroeder & Co., Sun Valley, $16,480; Jesse S. Smith, Glendale, $18,328; Southwest Paving Co., Sun Valley, $19,066; Warren-Southwest, Inc., Torrance, $19,256; Vernon Paving Co., Inc., Los Angeles, $19,370; Griffith Co., Los Angeles, $16,260. Contract awarded to C. O. Sparks & Mundo Engineering Co., Los Angeles, $16,260. Successful bidder determined by lot.

LOS ANGELES COUNTY—Firestone Boulevard between Central Avenue and Ivy Street, about 1.3 miles to be surfaced with plant-mixed surfacing. Dis-

trict VII, Route 174, Section B. M. S. Mecham & Sons, South Gate, $32,574; Vido Kovacevich Co., South Gate, $33,255; Jesse S. Smith, Glendale, $34,052; Warren Southwest, Inc., Torrance, $34,172; Griffith Co., Los Angeles, $34,516; Vernon Paving Co., Inc., Los Angeles, $35,128. Contract awarded to C. O. Sparks, Inc., & Mundo Engineering Co., Los Angeles, $32,395.

MENDOCINO COUNTY—Between Bacon Gulch and one-third mile north of Signal Port Creek, about 0.8 mile to be graded and surfaced with road-mixed surfacing on imported base material. District I, Route 56, Section A. Harold Smith, St. Helena, $98,981; O'Conner Bros., Red Bluff, $101,256; C. M. Syar, Vallejo, $101,674; Eugene G. Alves, Pittsburg, $104,700; Louis Biasotti & Son, Stockton, $106,457; John Burman & Sons, Eureka, $109,920; R. B. Guerin & Co., South San Francisco, $113,608; Chittenden & Chittenden, Auburn, $114,143; Fredrickson & Watson Construction Co., Oakland, $129,262; Miles & Bailey, Madera, $158,892. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, $97,905.

MENDOCINO COUNTY — At Salmon Creek about 20 miles south of Fort Bragg, about one mile to be graded, road-mixed surfacing to be constructed on cement treated imported base material and seal coats applied. District I, Route 56, Section D. Harold Smith, St. Helena, $106,045; Close Building Supply, Hayward, $107,648; Harms Bros & C. M. Syar, Sacramento, $109,603; Chittenden & Chittenden, Auburn, $112,498; O'Connor Bros., Red Bluff, $115,314; John Burman & Sons, Eureka, $116,390; Eugene G. Alves, Pittsburg, $121,786; R. B. Guerin & Co., South San Francisco, $126,446; Fredrickson & Watson Construction Co., Oakland, $129,878. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, $104,198.50.

MERCED COUNTY—Between 10.4 miles east of Los Banos and San Joaquin River, about 5.3 miles to be surfaced with plant-mixed surfacing on untreated rock base. District X, Route 32, Section C. P. J. Moore & Son, North Sacramento, $154,245; M. J. Ruddy & Son, Modesto, $155,586; Granite Construction Co., Watsonville, $156,823; Frank B. Marks, Jr., Newman, $167,990; J. R. Armstrong, El Cerrito, $174,277; Volpa Bros., Fresno, $175,220; Fredrickson Bros., Emeryville, $177,192; Rand Construction Co., Inc., Bakersfield, $180,538; Fredrickson-Watson Construction Co., Oakland, $189,173. Contract awarded to Valley Paving & Construction Co., Inc., Pismo Beach, $153,595.

MERCED COUNTY—Across San Joaquin River about 6 miles east of Gustine, a reinforced concrete slab bridge to be constructed and about 0.6 mile of roadway to be graded and surfaced with plant-mixed surfacing. District X, Route 122, Section A. J. R. Tout Co., Inc., Fresno, $103,605; C. B. Tuttle Co., Long Beach, $104,574; Thomas Construction Co., Burbank, $105,274; Chas MacClosky Co., San Francisco, $109,719; Fredrickson & Watson Construction Co., Oakland, $110,939; E. G. Perham, Los Angeles, $112,396; Dan Caputo & Edw. Keeble, San Jose, $112,417; Lew Jones Construction Co., San Jose, $114,895; M. A. Jenkins, Sacramento, $114,904; Erickson, Phillips & Weisbert, Oakland, $115,830; Granite Construction Co., Watsonville, $120,100; F. W. Case Co., Van Nuys, $126,356. Contract awarded to H. W. Ruby, Sacramento, $102,496.

MODOC COUNTY—Between Toms Creek and Cedarville, about 8.9 miles to be graded and surfaced with plant-mixed surfacing on cement treated base. District II, Route 28, Section C. Harms Bros., Sacramento, $331,183; A. Teichert & Son, Inc., Sacramento, $337,051; Clements & Co., Hayward, $337,619; McGillivray Construction Co., Sacramento, $338,738; Fredrickson & Watson Construction Co., Oakland, $370,807. Contract awarded to Rand Construction Co., Inc., Bakersfield, $303,851.

MONTEREY COUNTY—Between Spence Underpass and two miles south of Salinas, about 2.4 miles to be graded and surfaced with plant-mixed surfacing on cement treated base. District V, Route 2, Section B. Rice Bros., Inc., Marysville, $209,289; Ted F. Baun, Fresno, $212,442; Fredrickson & Watson Construction Co., Oakland, $239,574; Madonna Construction Co., San Luis Obispo, $239,644. Contract awarded to Granite Construction Co., Watsonville, $191,842.

MONTEREY COUNTY—Between Gonzales and Chualar, about 4.9 miles to be surfaced with plant-mixed surfacing and seal coats applied. District V, Route 2, Section C. Granite Construction Co., Watsonville, $89,193; Valley Paving and Construction Co., Inc., Pismo Beach, $89,548; G. W. Ellis Construction Co., North Hollywood, $89,705; Ted F. Baun, Fresno, $103,065; J. R. Armstrong, El Cerrito, $106,842; Harms Bros., Sacramento, $114,495; Brown Fly Co. Contr. & L. A. Forde, Corte Madera, $115,841; Rand Construction Co., Inc., Bakersfield, $121,213; J. Henry Harris, Berkeley, $122,877; Madonna Construction Co., San Luis Obispo, $124,800. Contract awarded to Rice Bros., Inc., Marysville, $84,865.

ORANGE COUNTY — In the City of San Clemente, between mile 1.77 at Avenida Valencia and mile 3.89, about 2.1 miles to be surfaced with plant-mixed surfacing. District VII, Route 2. Griffith Co., Los Angeles, $46,183; John J. Swigart Company, Torrance, $46,208; Cox Bros. Construction Co., Stanton, $54,331; R. P. Shea Co., Indio, $57,279; Peter Kiewit Sons' Co., Arcadia, $57,690. Contract awarded to Sully-Miller Contracting Co., Long Beach, $39,603.

ORANGE COUNTY — On Huntington Beach Boulevard, between Garfield Avenue and 23d Street, about 5.4 miles to be graded and surfaced with plant-mixed surfacing. District VII, Route 171, Section A. M. S. Mecham & Sons, South Gate, $138,824; Cox Bros. Construction Co., Stanton, $139,550. John J. Swigart Co., Torrance, $139,991; Peter Kiewit Sons' Co., Arcadia, $153,882; Griffith Co., Los Angeles, $154,176; Basich Bros. Construction Co. & Basich Bros., San Gabriel, $158,503. Contract awarded to Sully-Miller Contracting Co., Long Beach, $131,538.

SAN BERNARDINO COUNTY — Between San Antonio Avenue and Corona Street in the City of Ontario, about 2.7 miles, existing pavement to be resurfaced with plant-mixed surfacing. District VIII, Route 26. R. A. Erwin, Colton, $39,910; Griffith Co., Los Angeles, $41,133; Matich Bros., Colton, $41,200; Vido Kovacevich Co., South Gate, $42,525; American Asphalt Paving Co., Monrovia, $46,970; Cox Bros. Construction Co., Stanton, $47,448; Peter Kiewit Sons' Co., Arcadia, $48,436; Warren Southwest, Inc., Torrance, $48,719. Contract awarded to George Herz & Co., San Bernardino, $39,234.

SAN BERNARDINO COUNTY—Highland Avenue between 0.1 mile west of Riverside Avenue and 0.1 mile west of Cajon Creek, about 1.0 mile to be graded and surfaced with plant-mixed surfacing. District VIII, Route 190, Section B. George Herz & Co., San Bernardino, $39,995; E. L. Yeager Co., Riverside, $40,428; Matich Bros., Colton, $41,178; K & H Co., Colton, $42,459. Contract awarded to R. A. Erwin, Colton, $36,583.

SAN DIEGO COUNTY—Between Del Mar and San Onofre, portions about 11.2 miles in length to be surfaced with plant-mixed surfacing and seal coats applied. District XI, Route 2, Sections A,B,Ocn,D. R. P. Shea Construction Co., Indio, $199,305; Peter Kiewit Sons' Co., Arcadia, $208,914; G. W. Ellis Construction Co., North Hollywood, $222,572; R. E. Hazard Contracting Co., San Diego, $254,677. Contract awarded to Griffith Co., Los Angeles, $172,724.

EL DORADO COUNTY—Between one-half mile west and one-half mile east of South Fork American River near Lotus, about one mile of roadway to be graded and bituminous surface treatment applied thereto and a structural steel girder bridge with reinforced concrete deck to be constructed. District III, Route 65, Section B. Fredrickson Bros., Emeryville, $189,590; Al Erickson & Co. and Hunington Bros., Napa, $192,584; H. W. Ruby, Sacramento, $193,631; M. A. Jenkins & R. E. Hertal, Sacramento, $197,754; Chittenden & Chittenden & B. S. McElderry, Auburn, $201,917; Fredrickson & Watson Construction Co., Oakland, $208,000; Granite Construction Co., Watsonville, $208,032; Lord & Bishop, Sacramento, $215,045; Piombo Construction Co., San Francisco, $204,962; G. M. Carr & Bati Rocca, Santa Rosa, $220,856; Elmer J. Warner, Stockton, $225,539; O'Connor Bros., Red Bluff, $230,780; Charles MacClosky, San Francisco, $234,732. Contract awarded to Thomas Construction Co., Burbank, $188,891.50.

HUMBOLDT COUNTY — Between 0.5 mile south of Stone Lagoon Summit and one mile south of Orick, about 3.8 miles to be surfaced with plant-mixed surfacing on cement treated base. District I, Route 1, Section J. N. M. Ball Sons, Berkeley, $211,432; Harms Bros. & C. M. Syar, Sacramento, $213,805; Piombo Construction Co., San Francisco, $242,603. Contract awarded to Mercer Fraser Co. & Mercer Fraser Gas Co., Inc., Eureka, $203,177.

INYO COUNTY—Between Little Lake and 3 miles north, about 2.4 miles to be graded and surfaced with road-mixed surfacing on imported base material. District IX, Route 23, Section G. Browne & Krull, Hayward, $21,568; Westbrook & Pope, Sacramento, $21,613; Arthur A. Johnson, Laguna Beach, $22,973; R. A. Erwin, Colton, $23,772; Oilfields Trucking Co. & Phoenix Construction Co., Inc., Bakersfield, $24,751; E. S. & N. S. Johnson, Fullerton, $26,888; Roland T. Reynolds, Anaheim, $27,367; Bishop Engineering & Construction Co., Bishop, $30,001; The Boulden Construction Co., Van Nuys, $30,066; Rand Construction Co., Inc., Bakersfield, $32,257; Dix-Syl Construction Co., Inc., Bakersfield, $34,861. Contract awarded to Halloran & Gill, Bakersfield, $20,919.

IMPERIAL COUNTY—Between Holtville and Calipatria, portions about 7.4 miles to be surfaced with road-mixed surfacing on imported base material. District XI, Route 187, Sections B,C,D. Bent Construction Co., Los Angeles, $74,300; A. A. Edmondson, Glendale, $74,832; E. C. Young & Co., San Fernando, $75,780; Roland T. Reynolds, Anaheim, $76,869; Dimmitt & Taylor, Monrovia, $84,440; Covina Construction Co., Covina, $89,908. Contract awarded to Arthur A. Johnson, Laguna Beach, $71,770.

IMPERIAL COUNTY—Between Midway Wells and the Colorado River, portions about 9.7 miles in length to be surfaced with road-mixed surfacing. District XI, Route 27, Sections A,B. Arthur A. Johnson, Laguna Beach, $63,120; Dimmitt & Taylor, Monrovia, $72,685; E. C. Young & Co., San Fernando, $75,360; Covina Construction Co., Covina, $78,729; Clyde W. Wood & Sons, Inc., North Hollywood, $79,210. Contract awarded to E. S. & N. S. Johnson, Fullerton, $57,166.

LOS ANGELES COUNTY—On Olympic Boulevard, between Lemon Street and Boyle Avenue in Los Angeles, about 0.7 mile, existing pavement to be surfaced with plant-mixed surfacing. District VII, Route 173. C. O. Sparks, Inc., & Mundo Engineering Co., Los Angeles, $17,069; Vido Kovacevich Co., South Gate, $17,734; M. S. Mecham & Sons, South Gate, $17,823; Warren Southwest, Inc., Torrance, $18,338. Contract awarded to Griffith Co., Los Angeles, $16,491.70.

LOS ANGELES COUNTY — Across Rio Hondo Channel, on Anaheim-Telegraph Road, a structural steel beam bridge on concrete and treated timber pile bents and approaches between Gage Avenue and Tweedy Lane to be constructed. District VII, Route 166, Section A. Oberg Bros. Construction Co., Inglewood, $244,629; E. G. Perham, Los Angeles, $244,997; J. E. Haddock, Ltd., Pasadena, $247,786; C. B. Tuttle Co., Long Beach, $250,798; Griffith Co., Los Angeles, $254,153; K. B. Nicholas, Ontario, $257,112; W. J. Disteli, Los Angeles, $257,629; Byerts & Sons & Geo. K. Thatcher, Los Angeles, $259,014; Chas. MacClosky Co., San Francisco, $259,878; Ralph A. Bell, Monrovia, $262,350; Guy F. Atkinson Co., Long Beach, $264,524; Carlo Bongiovanni Construction Co., Los Angeles, $270,763. Contract awarded to Macco Corp., Paramount, $242,593.

LOS ANGELES COUNTY—At the intersection of Carson Street with Clark Avenue, furnish and install traffic signal system and highway lighting. District VII, Route 178, Section A. Electric & Machinery Service, Inc., South Gate, $8,193; Ed Seymour, Long Beach, $8,495; Clinton Electric Corp., Los Angeles, $8,578. Contract awarded to Westates Electrical Construction Co., Los Angeles, $8,096.

MONO COUNTY—Between one mile north of Grant Lake and junction with Route 23, about 1.5 miles to be graded and surfaced with road-mixed surfacing. District IX, Route 111, Section A. Ken Lowe, San Bernardino, $25,278; Steele & Easton, Sacramento, $26,730; Browne and Krull, Hayward, $28,847; Halloran & Gill, Bakersfield, $29,758; Dix-Syl Construction Co., Inc., Bakersfield, $31,526; Bishop Engineering & Construction Co., Bishop, $32,957; Downer & Eckley, Reno, $38,846. Contract awarded to Westbrook & Pope, Sacramento, $24,471.

ORANGE COUNTY—In the City of South Laguna, at the intersection of Pacific Coast Highway with Third Avenue, traffic signal system and intersection lighting to be furnished and installed.

. . . Continued on page 62

DOES A LONG-TIME PLANNING PROGRAM PAY DIVIDENDS?

This paper was presented by J. C. Wamack, Planning Engineer, Division of Highways, at the Second California Institute on Street and Highway Problems held in Los Angeles.

The question before us almost answers itself. Long-time programs are essential to the operation of any successful business. A successful street or highway program likewise requires a long-time plan and we in the California Division of Highways agree that a long-time highway planning program pays dividends.

There are three major considerations that make long-range planning not only desirable but absolutely essential in our work:

1. The magnitude of the job of bringing our state highways to acceptable modern standards;

2. The complex and extensive detail that is required to prepare modern highway projects for contract; and

3. The limitations of law which require that our funds be distributed among the several counties of the State in compliance with the formula established by the so-called Mayo amendment to the Collier-Burns Highway Act of 1947.

Critical Deficiencies

In preparing for the legislation which resulted in the Collier-Burns Highway Act of 1947 a list of critical deficiencies existing on our state highways was compiled by the Division of Highways. A program based on the elimination of these deficiencies is the core of our long-range planning. To meet and accomplish this long-range plan in an orderly manner advance planning sections have been established in our headquarters office in Sacramento and in the 11 district offices whose function it is to conduct each individual project from its inception up to a point where it can be turned over to the design section for detailed designing.

Five-year Program

Under our procedure the first step in setting up an actual program of projects to be considered for construction or for the purchase of rights of way is the preparation by the advance planning sections in the district offices, of a five-year planning program. These programs are a continuing process and are prepared each year for the subsequent five-year period. The first year of each of these periods is our tentative list of projects to be considered for inclusion in our current budget recommendation to the California Highway Commission.

An estimate of the probable total revenue that will be available for construction and the purchase of right of way for each of the succeeding years of the five-year period is furnished each of the districts, and upon the basis of these figures a list of projects is prepared.

Costs Distributed

Each project is located specifically between named termini within a county and is carefully estimated as to cost for the purchase of rights of way and for actual construction. These costs are then distributed with respect to fiscal years on the basis of the work that is contemplated for those fiscal years. On major projects the funds necessary for the purchase of rights of way may be spread over one or more years preceding the start of construction; also the cost for actual construction may be spread over more than one year, depending on the type and size of the project.

Headquarters Approval

These five-year planning programs, when completed by the districts, are forwarded to Sacramento for preliminary review by the headquarters planning section. During January of each year a conference is held in Sacramento with representatives of each district to discuss the program that they have submitted. The agreements and understandings reached at these meetings are presented to the State Highway Engineer for his consideration and approval. The approved planning program sets up the list of projects for which the districts are authorized to develop detailed design.

Project Reports

Projects included in approved five-year planning programs are now ready for the preparation of what we call our "project reports." These project reports which are prepared by the districts, are actually a thorough reconnaissance report of a proposed improvement carried out to consistent conclusions and recommendations.

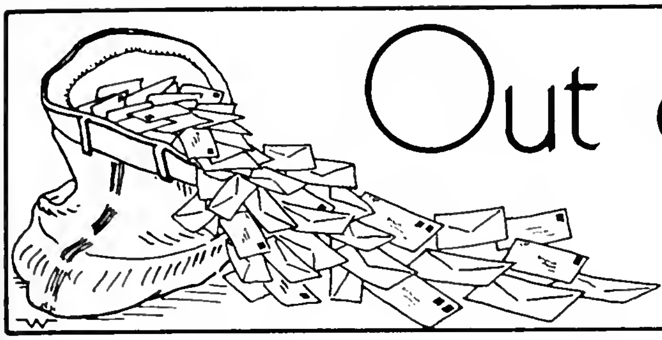
An outline for a typical project report is as follows:

1. General description;
2. Origin of project;
3. Justification and benefits;
   - A. Traffic warrants;
   - B. Economic benefits;
   - C. Structural warrants;
4. Right of way;
5. Conclusion;
6. Recommended action;
7. Data to accompany report;
   - A. Estimate of cost;
   - B. Soils and material data;
   - C. Over-all map of project;
   - D. Typical section;
   - E. Schematic drawings including tentative intersection treatment;
   - F. Traffic charts and accident data;
   - G. Photographs.

Long-time Plan Pays

Each project report that is submitted to headquarters is subject to review and comments from the various interested departments and to the final approval of the State Highway Engineer. This orderly analysis of all proposed highway undertakings insures a full presentation of the objectives sought, a proper determination on location and standards, a reliable estimate of cost and a definite understanding as to the procedure. Moreover, it results in establishing consistent standards and policies for all routes and, of considerable importance, it builds up a record which in time will constitute a coverage of all routes and present the background for ascribing correct priorities for future financing.

Experience is conclusive, to us, that long-time plans pay dividends.



Out of the Mail Bag

WE LIKE THIS

Surrey Hills
MELBOURNE, AUSTRALIA

California Highways and Public Works
Sacramento, California

DEAR SIRS: I am grateful for my continued reception of your journal, and hope that I may remain on your mailing list.

Your courageous progress is an inspiration to us here. My co-readers and self congratulate you on it.

We look forward to the receipt of each journal, and take pride in your achievements.

Yours sincerely,
ARTHUR O. GYLES

ROAD CONSCIOUS

CAMP AND TRAIL CLUB
OAKLAND, CALIFORNIA

KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

SIR: The members have asked me to write and thank you for the *California Highways and Public Works* magazine that you have been sending to us. We want you to know that we enjoy this magazine and that we are now "road conscious," which we never were before we received it.

After I am sure that every member has read the magazine, I mail it to a cousin in Northern Ireland. He works on the roads there and is always glad to receive the magazine.

So we hope that you will keep us on your mailing list.

Thanking you, I remain,
WILLIAM F. NEVIN
Secretary, Camp and Trail Club
Chapter No. 3

DOING GOOD WORK

F. H. BENHARD
Public Relations Manager
Nevada U. S. 40 Highway Assn.

COLFAX, CALIFORNIA

MR. KENNETH C. ADAMS, *Editor*
California Highways and
Public Works
Sacramento, California

DEAR MR. ADAMS: I am enclosing postcard asking to be retained on your mailing list, and am taking this occasion to express to you our association's great appreciation and admiration for your very interesting and comprehensively informative publication.

You are probably familiar with the fact that the Nevada U. S. 40 Highway Association not only concerns itself with all highways leading to Utah, Nevada and Northern California, but also with other surface transportation systems which bring business and tourist trade to the area between the Rockies and the Sacramento Valley.

Thank you for your numerous courtesies.

Very truly yours,
F. H. BENHARD

APPRECIATION

91 Browett Road
COUNDON, COVENTRY, ENGLAND

California Highways and Public Works
Sacramento, California

DEAR SIRS: Thank you very much indeed for putting my name on your mailing list for your magazine. I have received two copies so far and have found them interesting in every way, especially as I am an architectural student here in Coventry, England.

Yours sincerely,
LESLIE A. COCKERILL

HAVANA UNIVERSITY

HAVANA, CUBA

CALIFORNIA HIGHWAYS AND
PUBLIC WORKS
Sacramento, California

GENTLEMEN: Again I have pleasure in thanking you for mailing me your valuable magazine *California Highways and Public Works*, which I always look over carefully and from which I take many clippings.

Yours very truly,
JOSE R. SUST
Assistant Professor of Streets and Highways, School of Engineering, University of Havana

OLD SUBSCRIBER

1210 Diana Road
SANTA BARBARA

California Highways and Public Works
Sacramento, California

GENTLEMEN: This past year was the tenth year I have received *California Highways and Public Works*. Ten years ago I was a student in school when I ran across a copy in the school library. At that time I was majoring in civil engineering. A lot has happened since then.

There was a war; then after I came back I switched my major to business. Now I am a traveling salesman; therefore I am still very much interested in our highways.

I probably have the distinction of being one of your youngest subscribers. I am now 24, which would make me just 14 when I received the first copy of the magazine.

There will be many more 10 years for me; hope there will be for you.

Sincerely,
BILL EVERETT.

Auburn Study

Continued from page 6 . . .

The sections labeled *A* and *B* on the map are the centers of business activities in the City of Auburn and here exist the highest property values. Section B is along the route of the former highway, while Section A is just off the main through lanes of travel. It is in the first block along Section A (Lincoln Way) that the 100 percent locations exist.

New Buildings

It is interesting to note that the very best business locations were not fronting on the highway, but rather slightly removed therefrom. Apparently the heavy traffic along the highway had hampered business growth along High Street (Section B) so that it was not until after freeway construction began and the prospect of through traffic removal became a certainty that new retail business building began. The new Livingston Building, housing complete modern shopping facilities, pictured herein was built during this period along the former highway.

Section C of the map is the historic original section of Auburn existing today much as it did during the mining days before 1900. Some of the old buildings built in this early era, still business-occupied, are pictured in these pages. The narrow, crooked street shown is the westerly entrance to Auburn and formedly carried all U. S. Highway 40 traffic headed eastward or westward. Properties in this section have not changed hands for many years. Businesses here, most of them cafes and bars, showed benefits resulting from the freeway installation. Rental rates have remained unchanged.

Values Remain Equal

The section of former highway northeasterly of the main business district from the railroad underpass, which forms the upper limit to the business district, to its connection with the new freeway, is abutted by property formerly, and still, classified as having either a commercial or residential highest and best use. Values for either use have remained about equal, being approximately $1,000 to $2,000 per building "site." (See Section D of Map.)

The existence of miles of undeveloped property of this type along the highway had apparently held down the value of the property for a potential commercial use, much as is true along the highways throughout the State. It is evident that all of the highway frontage available can not be profitably developed into commercial property in the foreseeable future. The very remoteness of this potentiality has reasonably held down the values.

Residential Development

Considered for residential development, this section of superseded highway has shown a marked improvement in desirability, if not any substantial increase in value. Probably this is due to the removal of 78 percent of the traffic from this section of the roadway and removal of almost all of the heavy though truck traffic.

Most traffic from the highway entering the City of Auburn now uses one of the approaches near the business district.

Having discovered that the retail sales in Auburn are up well above the logical expectancy since opening the freeway, that parking meter returns have increased, and that the drop in traffic along the city's main street has corresponded almost exactly with the traffic drop along the highway, and assuming the obvious—that all highway traffic does not now pass through the city—our inevitable conclusion is that shoppers from the surrounding areas who had formerly traded elsewhere are now patronizing Auburn merchants.

The fact that over-all retail sales displayed such a marked increase also indicates that highway travelers who formerly stopped en route to their destinations are still turning off the freeway into the historic little city for leisurely dining, service and shopping.

In summarizing the apparent effect of the Auburn freeway on business and property values, with consideration of the effects on traffic along the different sections of the highway in the old section of Auburn, in the modern business section of the city, and along the only partially developed section northeast of the city to its connection with the freeway, we are able to state that the analysis of all factors indicates definite benefits and no harmful effects to any type of property or retail business class.

Bids and Awards

Continued from page 59 . . .

District VII, Route 60, Section C. Westates Electrical Construction Co., Los Angeles, $3,884; Electric & Machinery Service, Inc., South Gate, $4,151. Contract awarded to Clinton Electric Corp., Los Angeles, $3,845.

ORANGE & RIVERSIDE COUNTIES—Between 1.7 miles west of Orange County line and Corona, about 4.9 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and existing surfacing. District VIII, Route 43, Sections B,A. Grilbth Co., Los Angeles, $446,879; R. A. Erwin, Colton, $450,497; R. P. Shea Construction Co., Indio, $465,108; E. L. Yeager Co., Riverside, $466,125; A. Teichert & Son, Inc., Sacramento, $478,665; Basich Bros. Construction Co. & Basich Bros., San Gabriel, $486,013; Cox Bros. Construction Co. & J. E. Haddock, Ltd., Pasadena, $497,-142; N. M. Ball Sons, Berkeley, $579,536. Contract awarded to Peter Kiewit Sons' Co., Arcadia, $444,-857.10.

SAN FRANCISCO COUNTY—In the City and County of San Francisco at State Highway building, parking areas and service area, including sidewalks, curbs, fences, drainage facilities and lighting, to be constructed and installed. District IV. O. C. Jones & Sons Co., Berkeley, $19,373; The Lowrie Paving Co., Inc., San Francisco, $19,413; Eaton & Smith, San Francisco, $22,839; J. Henry Harris, Berkeley, $27,020; Minton & Kubon, San Francisco, $27,438; The Fay Improvement Co., San Francisco, $27,499; Contract awarded to Chas. L. Harney, Inc., San Francisco, $19,326.20.

SAN BERNARDINO COUNTY—In the City of Redlands, between north city limits and Route 26, and between Orange Street and east city limits, about 4.4 miles to be surfaced with plant-mixed surfacing. District VIII, Route 190. Matich Bros., Colton, $28,825; R. A. Erwin, Colton, $29,457. Contract awarded to George Herz & Co., San Bernardino, $27,325.50.

SAN DIEGO COUNTY—Between Miramar and Lake Hodges, about 11.8 miles to be surfaced with plant-mixed surfacing and seal coats applied. District XI, Route 77, Sections A,B. Griffith Co., Los Angeles, $215,884; Cox Bros. Construction Co., Stanton, $236,993; Clyde W. Wood & Sons, Inc., North Hollywood, $238,403; R. P. Shea Construction Co., Indio, $261,403. Contract awarded to Peter Kiewit Sons Co., Arcadia, $207,943.

SAN JOAQUIN COUNTY—Four miles east of Terminous, about 0.3 mile to be graded and surfaced with plant-mixed surfacing. District X, Route 53, Section C. M.J.B. Construction Co., Stockton, $24,-235; A. Teichert & Son, Inc., Sacramento, $27,042; Eugene G. Alves, Pittsburg, $27,065; Louis Biasotti & Son, Stockton, $28,027; Tyson & Watters, Inc., Sacramento, $32,073. Contract awarded to Claude C. Wood Co., Lodi, $23,777.10.

SANTA CLARA COUNTY—At various locations between 3.3 miles south of San Jose and Madrone, about 5.8 miles to be resurfaced with plant-mixed surfacing. District IV, Route 2, Section B. A. J. Raisch Paving Co., San Jose, $103,400; Granite Construction Co., Watsonville, $111,168; Rand Construction Co., Inc., Bakersfield, $105,868; Frank B. Marks, Jr., Newman, $113,410; Harms Bros., Sacramento, $118,225. Contract awarded to Leo F. Piazza, San Jose, $100,406.25.

STANISLAUS COUNTY — Between junction with Route 109 and one mile east of Oakdale, about 11.2 miles to be surfaced with plant-mixed surfacing on untreated rock base. District X, Route 13, Sections A,Rvbk,A,Okdle,B. Granite Construction Co., Watsonville, $199,865; M. J. Ruddy & Son, Modesto, $204,765; Rand Construction Co. Inc., Bakersfield, $212,142; N. M. Ball Sons, Berkeley, $214,553; M.J.B. Construction Co., Stockton, $217,187; Harms Bros., Sacramento, $225,707; Fredrickson Bros., Emeryville, $228,239; United Concrete Pipe Corp., Baldwin Park, $232,870; Rice Bros. Inc., Marysville, $239,897; Fredrickson & Watson Construction Co., Oakland, $244,009; McGillivray Construction Co., Sacramento, $247,-260; A. Teichert & Son, Inc., Sacramento, $246,315. Contract awarded to Munn & Perkins, Modesto, $197,800.

Adieu

Continued from page 20 . . .

of its type ever built, was expected to serve for 20 years. The particular feature of this bridge that gives it strength and adds to its life is that all members are in compression. The bridge is 220 feet long and cost $7,800."

During these early years in District I, Mr. Haselwood must have acquired some of the qualities of resourcefulness that he praises in Mr. Sonner. Shortly after he took over as district engineer in District II, he was assigned just about as tough a problem in location and construction that ever confronted a highway engineer: the location and construction of a highway between Weaverville and Junction City over Oregon Hill in Trinity County.

Oregon Hill is a mass of gold-bearing gravel that once was part of an ancient stream bed left high above the present river by earth movements millions of years ago. It was the site of the LaGrange Hydraulic Mine, one of the largest in the world, which was actively operated from 1862 until 1918.

Oregon Hill offered very little support for a highway location, except at right angles to the direction it should go, and a direct ascent over the hill involved a 200-foot cut through the mountain as well as through an immense slide of several million cubic yards' extent on the rim of the old mine. Moving this much material was, of course, impossible by ordinary methods of road building.

However, Mr. Haselwood once stated that unusual problems call for unique solutions, and when mountains get in the way of highways they must be moved. And move one he did.

A portion of the water system that supplied the mining operations was still in existence, and a study of the situation proved that it would be feasible to remove the slide and cut through the mountain by the hydraulic mining method. Soon the largest hydraulic operation ever undertaken on highway work was under way with two 8-inch giant monitors slicing down over 5,000 cubic yards of earth an hour. Over 10,000,000 yards were removed in five years by this method, and traffic now travels through Oregon Hill very near the bed of a river millions of years old.

One of the outstanding highway achievements completed under the guidance of Mr. Haselwood was the construction of the Oroville-Quincy or Feather River Highway. He made a complete reconnaissance of this route in 1927 while in District III. This section had become a part of District II by the time he transferred to Redding in 1932, and he directed the completion of surveys and plans and construction of a good many miles of this route. The location follows the Feather River and its tributaries for 70 miles, and the many precipitous areas through rugged canyons with steep and bare granite walls presented some formidable problems in design and construction. For 10 miles between Pulga and Rock Creek the road is cut in the solid walls of the canyon, and three tunnels pierce precipitous points in the Arch Rock, Grizzly Dome, and Elephant Butte areas.

This $8,000,000 dollar highway was opened to public traffic in 1937 after nine years of intensive construction work by two prison road camps and several contracts. For the engineers, this was the completion of a task, the magnitude and complexity of which is rarely encountered. For the people of Plumas County it was the culmination of a 70-year-old dream, and for the people of the State of California this highway has become a facility of steadily increasing service.

Many other notable highway projects, too numerous to detail here, have been guided to a successful completion by Mr. Haselwood in recent years. Included in these are the relocation of the highway around Shasta Reservoir north of Shasta Dam, and many miles of modern freeways on U. S. 99 in District II.

Other than a trip into Canada this summer, his plans for the future are unformulated, so that he will be free at any time to travel and see and do the things he has never taken time out for in the past. All members of the organization wish him well and sincerely hope that in whatever he undertakes he will derive the pleasure and benefits that are most certainly due him.

He can retire with the satisfaction of a job well done and can well be proud of the important role he has played in the pioneering and expansion of our highway system. Many miles of our modern highways will remain as constant reminders of his service to the people of this State, not only as an engineer, but also as an individual vitally interested in progress.

Intersection Lighting

Continued from page 50 . . .

period, and all of the timing intervals of the dispatcher are affected and modified accordingly. The dispatcher is so designed that it automatically balances the car seconds of delay on the street having the red light against the car seconds of delay which would result were the traffic stopped on the street having the green light. Because of the processes of automatic and continuous balance, it is possible not only to eliminate all unnecessary delay, but materially reduce the total delay at the intersection.

Vehicle detectors have been installed in each approach to the intersection. Allocation of the green light is made on the basis of maximum demand, thereby assuring that the greatest possible traffic volumes will always move through the intersection.

The greatest time saving feature of the traffic actuated signal is that if there are no cars on an approach to the intersection, the signal dispatcher will not give a green light to that street. The green light will remain on the street which had the last car go through the intersection, and the green light will remain until the detectors on the other approaches to the intersection are actuated. This system is quite different from the electric motor operated timers on the city streets which change the green light from one street to the other regardless of the traffic.

A left turn lane is provided for the southbound traffic desiring to turn left into Fruitridge Road. When a vehicle enters the left turn lane it actuates the detector which lets the dispatcher know that the vehicle desires to make a left turn, and at the earliest possible moment a left turn green arrow will appear on the separate signal which is provided over the intersection for the left turn traffic.

Prison Labor

Continued from page 44 . . .

pares favorably with that of average free labor on similar work.

To become eligible for the camps, inmates must not only have good behavior records in prison but they must volunteer for the assignment, and in order to remain in a camp and retain the privilege of earning a wage, they must work diligently and produce satisfactory work or be returned to the institution.*

Through proper selection and encouragement of the good workers, efficient inmate labor crews are built up that are surprisingly productive.

An excerpt from the First Biennial Report of the California Highway Commission, dated December 31, 1918, describing a Northern California camp, indicates that the same relative efficiency prevailed in the early days of the camp:

"We are building a road 12 feet wide in excavation and 14 feet wide in embankment and all in rough, rugged mountainous country, where transportation of men and supplies is expensive in summer and almost out of the question in winter. Enough supplies must be stored in camp by the middle of November to last until the middle of April."

"Just now the convict camp is very efficient. Comparing it with free labor, the convict will do more work than the average free laborer available at the present time."

CONCLUSIONS

As indicated heretofore, the purpose of this series of articles on prison road camps in California is to record the history, legislation, organization, and administrative procedures developed over 34 years of continuous operation of the camps since 1915.

Experience over this period indicates that there is comparatively no advantage over the contract method in the employment of prisoners for building highways insofar as the economics of highway construction are concerned.

The employment of prisoners in the road camps however, results in advantages to the State aside from the important benefits to the prison system.

By agreement with the Department of Corrections, State Department of Natural Resources, and the U. S. Forest Service, road camp inmates are advantageously utilized for the suppression of forest fires and are of particular value for emergency use in the early stages of a fire within a reasonable distance from the camp.

Through the employment of prison labor, construction has been advanced several years on many of the State's highways in remote mountainous areas that could not have otherwise been financed.

It is the policy of the department, where required to operate prison road camps under directive legislation, to operate them as efficiently as possible with due consideration for prison requirements and maximum return on the highway dollar.

Administrative road camp personnel is tuned to this policy.

* See article on "Organization" in the May June, 1949, issue of *California Highways and Public Works*.

AUTHOR'S NOTE:

The author wishes to acknowledge the helpful suggestions of Mr. P. R. Watson, Jr., Assistant Construction Engineer, who has been in charge of general supervision of the road camps since September, 1947, and also Mr. C. J. Tyack, Accountant in charge of prison road camp accounting for the Division of Highways.

The author also wishes to express his appreciation of the considerate cooperation given by Mr. John H. Klinger, Deputy Director of the Department of Corrections, in reviewing the original copy of each of these articles.

EDITOR'S NOTE:

This article concludes the series of seven articles on prison road camps.

In Memoriam

WILLIAM J. LENTZ

William J. Lentz, Associate Chemical Testing Engineer with the Materials and Research Department, passed away suddenly March 31, 1950. Mr. Lentz was stricken with a heart attack.

A veteran of two wars, Mr. Lentz had served the Materials and Research Department for 28 years. Born October 19, 1893, in Truckee, California, he came to Sacramento at an early age and was graduated from Sacramento High School.

His first employment with the State of California was for a short period with the State Purchasing Division prior to World War I. After his return from France, where he served with the Chemical Warfare Service, he accepted a position as Chemist with the Southern Pacific Company.

He joined the staff of the Materials and Research Department in 1922, and remained there until his death, with the exception of two years with the Chemical Warfare Service during World War II, during which time he was stationed at Edgewood Arsenal with the rank of Captain.

He was a member of the American Chemical Society and was well-known in paint and varnish circles due to his work in formulating specifications for protective coatings for highway use.

He resided at 530 46th Street, Sacramento, and is survived by his widow, Mrs. Aileen Lentz.

Erosion Control

Continued from page 40 . . .

It should be emphasized here that the establishment of an adequate growth of permanent trees and shrubs to reinforce the relatively short-lived Baccharis and willow planting is highly desirable in localities where soil type and rainfall intensity justify these elaborate control measures. Tree and shrub roots, penetrating the fill material, consolidate and bind it to a degree obtainable by no other means, and by the time brush layers rot or wire rusts away these roots are capable of holding the soil firmly in place. Thus, truly permanent control can be established.

Average Costs

The average cost of these various methods, based on 1947, 1948, and 1949 bids is as follows:

	Per lineal foot
Brush layers	\$0.17
Wire reinforced brush mats	\$0.50
(One contractor stated his actual cost was over \$1 per lineal foot.)	
Wire mesh mats (camouflage netting)	\$0.55 to \$0.75
(The State furnished war surplus camouflage netting at no cost to the contractor for these mats.)	
Wire mesh mats (poultry netting)	\$1.15
Straw mat: No costs available.	

Straw, furnished and spread on the slopes in two applications at the total rate of six tons per acre, averaged about \$64 per ton, or \$384 per acre. The cost of rolling or compacting slopes, which was set up as a separate item on these contracts, ranged from \$0.08 to \$0.12 per square yard, or \$387.20 to \$580 per acre.

. . . to be continued

EARL WARREN
Governor of California

•

CHARLES H. PURCELL
Director of Public Works

•

FRANK B. DURKEE
Deputy Director

•

HIGHWAY COMMISSION

C. H. PURCELL . . . . Chairman
HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
FRED J. GRUMM . . Deputy State Highway Engineer
J. G. STANDLEY . . Assistant State Highway Engineer
R. M. GILLIS . . . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
T. E. STANTON . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
C. E. WAITE . . . . Engineer of Design
EARL WITHYCOMBE . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L.V.CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

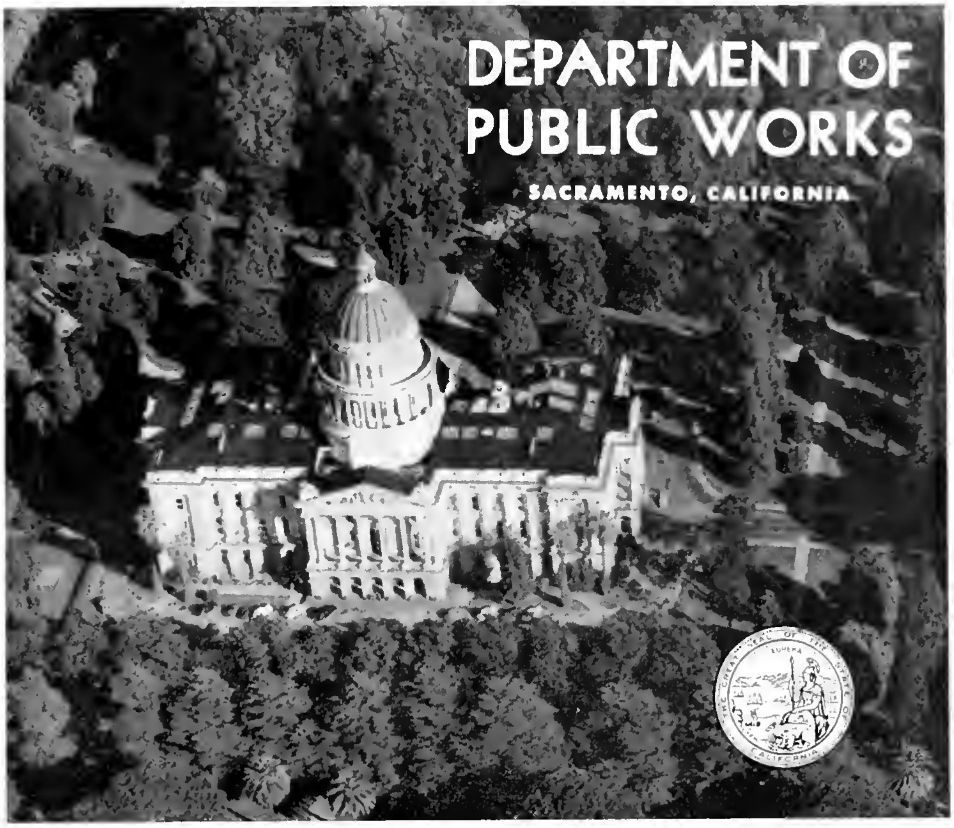
FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

District VII

P. O. HARDING . . Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
F. W. HASELWOOD . . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
E. Q. SULLIVAN . . . District VIII, San Bernardino
S. W. LOWDEN . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. R. SIMPSON
Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
W. K. DANIELS . Assistant State Architect (Administrative)
P. T. POAGE Assistant State Architect (Design and Planning)
D. C. WILLETT . . . . Chief Construction Engineer

Headquarters

A. F. DUDMAN . . . Principal Architectural Designer
C. L. IVERSON . Supervising Architectural Draftsman
CARLETON PIERSON . . Supervising Specification Writer
FRANK A. JOHNSON . . Principal Structural Engineer
C. A. HENDERLONG
Principal Mechanical and Electrical Engineer
WADE HALSTEAD . . . . . Supervising Estimator

Schools

W. H. PETERSEN Principal Structural Engineer, Sacramento
H. W. BOLIN . Principal Structural Engineer, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 25870 5-50 26,400

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

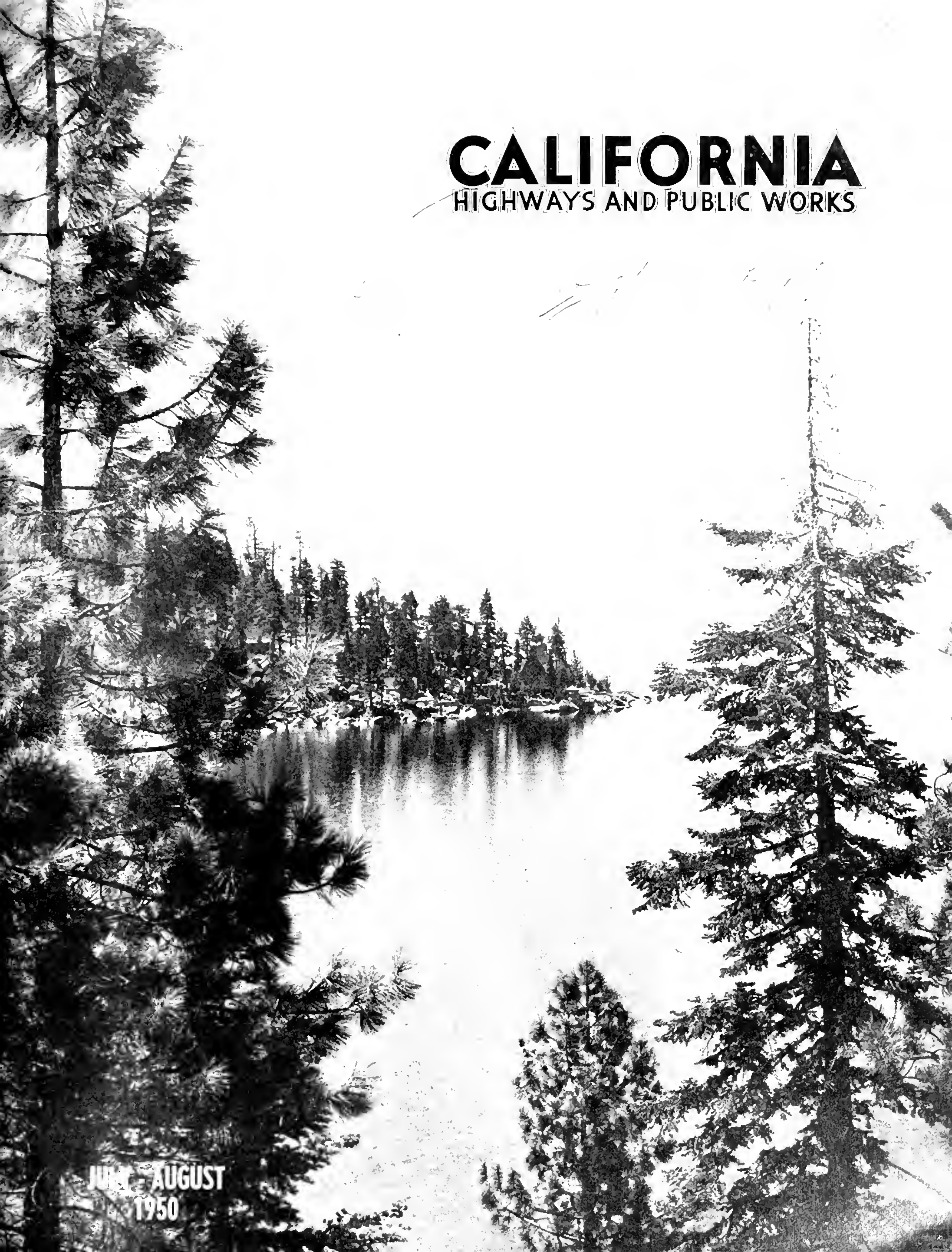
RETURN POSTAGE GUARANTEED

Seattle Public Library,
Seattle,
Wash.

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



JUNE - AUGUST
1950

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 July-August Nos. 5, 6

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

Freeway Law

High Courts Uphold Validity of Statutes; Approve State's Power to Relocate and Improve Highways

By FRANK B. DURKEE, Deputy Director of Public Works *

QUESTIONS regarding powers of the California Highway Commission and the Department of Public Works with respect to relocation and improvement of highways and the construction of freeways—questions some of which have been raised but not conclusively answered for more than a generation — were decisively disposed of by recent decisions of the Fourth District Court of Appeal and of the Supreme Court of California. In each instance the opinion was concurred in by a unanimous court and in each instance the position of the commission and the department was upheld.

Frank B. Durkee

As further hearings have been denied in both cases, these decisions may now be considered final. Because of their importance to the highway program, it appears appropriate that they be reviewed briefly in *California Highways and Public Works.*

Sacramento County Freeway Case

The first of the cases, that of *Holloway* v. *Purcell,* 35 A. C. 226, was, in effect, an all-out legal attack on the freeway program of the State. Its basic purpose was, as was pointed out in the department's brief, to hold the present highway on its existing alignment, the plaintiff property owners assuming that thereby their roadside businesses would continue to be benefited.

The *Holloway* case arose in Sacramento County and was an action to enjoin the proposed relocation (as a freeway) of a portion of statutory Route 3 (U. S. 40, 99E) between North Sacramento and Roseville. In the superior court, Judge B. F. Van Dyke sustained a demurrer to the complaint without leave to amend and entered judgment dismissing the action. This judgment was affirmed by the Supreme Court in an opinion handed down on April 25, 1950. A petition for a rehearing has been denied.

The situation in *Holloway* v. *Purcell* is shown on the map, entitled "From North Sacramento Freeway to ½ Mile East of Roseville," which accompanies this article. The present location of the section of Route 3 involved is indicated as "Existing State Highway Route 3" and the new alignment, on which it is to be relocated, as a freeway, is in double line captioned "Proposed Relocation." This portion of Route 3 came into the State Highway System some 35 years ago as one of the original "bond issue roads"; that is, pursuant to provisions of the State Highway Act of 1909 (Stats. 1909, Chap. 383).

In the *Holloway* case, the attack on the proposed highway relocation was based on two major contentions: First, that the California Highway Commission presently is without power to approve relocation of a bond act highway; and, second, that the California Freeway Law is unconstitutional.

The court, speaking through Mr. Justice Traynor, answered the first of these contentions by saying that "there is ample statutory authority for the State Highway Commission to relocate any part of the State Highway System," citing California Streets and Highways Code, Section 71, and, also, as respects the particular section of highway here involved (which is a federal-aid highway), provisions of the Federal Highway Act to which the State has assented.

The plaintiffs had contended that "the location of Route 3 is fixed by the terms of the State Highways Act of 1909, * * *, under which it was acquired by the State, * * *, and cannot be changed until the principal and interest on the indebtedness authorized by that act has been paid."[1] They had asserted that "the statutes authorizing the relocation of state highways constructed or acquired under the 1909 act are unconstitutional on the ground that they accomplish a repeal of the provisions of that act in violation of Article XVI, Section 1 of the California Constitution." "This contention," the court said, "is without merit."

The principal argument of the plaintiffs on the question of the power of the commission to approve relocation of bond act roads appears, however, to have been based on certain language contained in Section 8 of the 1909 act providing that the highways "constructed or acquired" thereunder were to be "permanent in character" and were to be "permanently maintained and controlled by the State of California." While this language has never been interpreted by the department, or judiciously construed to have the effect contended for by the plaintiffs in the *Holloway* case, it is nevertheless true that its exact meaning has been questioned and has, in the past, been the subject of controversy.

With respect to the use in the statute of the words "permanent in character," the court said:

> "Plaintiffs interpret permanence to preclude changes from established routes. There is no support for so narrow a construction. The sentence specifically relates permanence to character of construction, not to location as is evident from the words 'finished with oil or macadam or a combination of both as in the judgment of the said department of engineering shall be most suitable and best adapted to the particular locality traversed.' In specifying hard surface materials it envisages highways that are built and maintained to endure. There is no implication that the site selected will remain forever. * * *. A duty to construct and maintain highways 'permanent in character' does not preclude relocation or realignment of highways to meet the changing needs of traffic. The sense

. . . Continued on page 30

* Before appointment to his present position, Mr. Durkee served as a principal attorney on the legal staff of the Department of Public Works.—Editor.

[1] A portion of this indebtedness remains unpaid as of the present time.

Notable Career

Fred J. Grumm Concludes Long Service With Division of Highways

Retirement of Fred J. Grumm, Deputy State Highway Engineer, on August 1, 1950, brought to a close an outstanding career of public service with the California Division of Highways. This service started with the California Highway Commission in 1922 at Headquarters in Sacramento,

Fred J. Grumm—1950

where he was in charge of the drafting room and supervision of design. During the last part of 1922 and first part of 1923 he was transferred to District VI, Fresno, as Assistant Division Engineer, from where he returned to Sacramento and became the Engineer of Surveys and Plans holding that position until 1943. In 1943 he was promoted to the position of Assistant State Highway Engineer and in 1947 he was again promoted to the position of Deputy State Highway Engineer, which position he held until his retirement.

Career Prior to State Service

Prior to entering state service, Mr. Grumm was employed in 1908 and 1909 with the San Diego County Highway Commission on a program for the improvement of a major county highway system. The establishment of this system was the first of its kind in the State of California and was the forerunner of other similar highway work in the State.

For a short period in 1909 and early 1910, Mr. Grumm was associated with the San Diego and Arizona Railroad. In 1910 he became Deputy County Surveyor of San Diego County and in that capacity laid the foundation for his career in road and highway work. In 1918 he returned to the newly formed San Diego County Highway Commission where he remained until 1922 when his state service started. During these years with the San Diego County Highway Commission he was in charge of office, supervision of design, estimates, plans and specifications for the improvement of highways on a major program financed by bond issue. Mr. R. M. Morton, later State Highway Engineer, was the chief engineer of this project.

In the early years of his administration of the Surveys and Plans Department it was necessary to organize the planning of highway projects on a state-wide basis. As an aid to this standardization, a Manual of Instructions was published in 1925 by the Surveys and Plans Department, which was the first publication in the State pertaining to these functions.

At this time it was the duty of the Surveys and Plans Engineer to administer the general planning of the various highway routing studies. In these early years the primary considerations were mainly those of geometric design and of alignment and gradient. Selection of type of surfacing was relatively simple, being confined either to untreated road metal, oil macadam or Portland cement concrete, placed directly on the native soil.

In making the various routing studies, Mr. Grumm obtained an intimate knowledge of the roads throughout the State, and with his good memory, these early activities have been of great assistance throughout his entire service with the Division of Highways.

Incidents During Early Trips

He recalls numerous incidents which occurred during the studies made in connection with routings of various

Fred J. Grumm—1923

state highways, some of them humorous in retrospect.

In 1925 he made a trip with Mr. Sullivan, District Engineer in San Bernardino, and Judge Van Dyke of Daggett. They went easterly across the Mojave Desert and the mountain ranges, traveling in two cars for four days. They were contemplating the junction of a route through the desert as a combination of the road entering the State from both Needles and Las Vegas, which would save many extra miles of highway construction. They were in the locality traversed by Father Garces on his explorations in the 1770's and by Jedediah Smith, one of the early mountain men, in 1826. This party named a pass after Father Garces,

which is in the most easterly and highest range of hills and is the only likely place where the crossing could have been made.

As a contrast to the trip in the desert, two weeks later Mr. Grumm was in Del Norte County picking his way through sloughs looking for a desirable location for a state highway route from the Oregon line to Crescent City.

On another early trip, made in the company of Ed Wallace, now District Highway Engineer, San Diego; Tom Stanton, now Materials and Research Engineer; Chet Warlow, present State Highway Commissioner, and Dick Downs, this group left Cedar Grove and walked over the possible location of the now Kings River Highway in the Kings Canyon. During this trip it was necessary to cross the Kings River many times and these crossings were made by wading the river and with the aid of ropes. On the second day of the hike they reached the location known as Horseshoe Bend. Finding that the water was too high to permit their crossing, it was necessary to climb the adjacent sheer bluff which is some 1,500 feet in elevation above the river. About midnight they reached the junction of the north and middle forks which was the previously selected camp site for that day.

As the entire group was exhausted, they crawled into their sleeping bags and beds without bothering to prepare any supper. During the early morning hours they were awakened to find that a skunk had gotten into their supply of steaks and the whole party was aroused, and began throwing rocks at the skunk to save the food for the much needed breakfast in the morning. The party was picked up about midnight on the third day and most of them had their clothes practically torn off and Mr. Grumm had a very severe case of poison oak, which had swollen his eyes almost shut. As he recalls, it was necessary for Mr. Warlow to accompany him to a hotel in Fresno to certify that he was even human. The finale to the whole trip occurred the next morning when they were checking out of the hotel, preparatory to returning to Sacramento. They found that all of their money had been so watersoaked due to the repeated wadings and crossings of the river that it could not be recognized and it was necessary to write a check to pay their hotel bill.

Upon another occasion, Mr. Grumm accompanied Mr. Bedford on a trip in Lake County on which they were looking for a desirable route from the Sacramento Valley to the coast. On this reconnaissance survey every canyon to the east, from the north fork of Cache Creek down to Grizzly Creek, was traversed from top to bottom. Grizzly Creek is now the location of Highway Route 15.

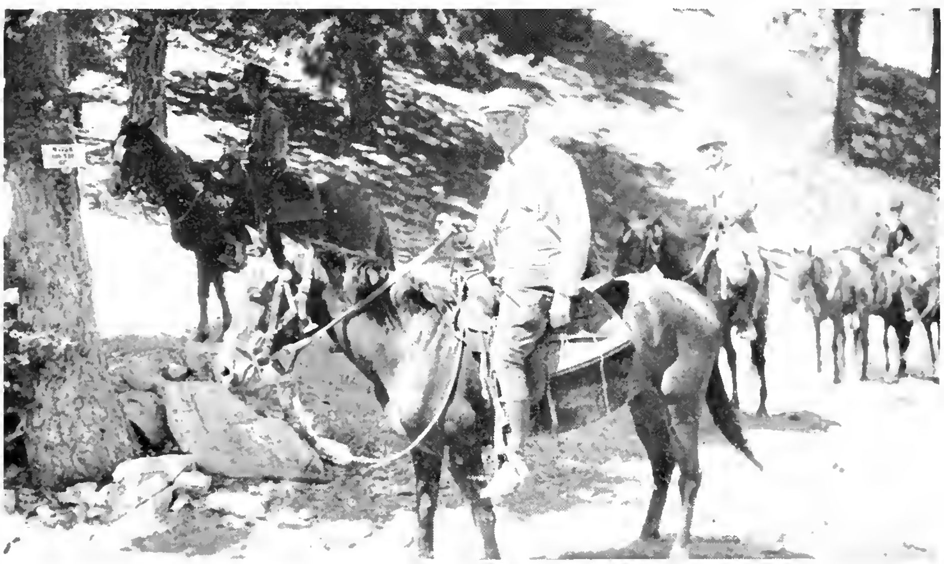
The duties as Surveys and Plans Engineer gradually developed to include work of preparing reports to the Legislature on the status and condition of the State Highway System. The associations Mr. Grumm developed through the years with various legislative committees of the House and the Senate earned for him and the department a reputation for supplying up-to-date, correct and reliable information regarding highway matters.

In 1922 there were less than 1,000,000 registered vehicles in the State of California and highway capacity was not one of the engineering problems. However, during the early 1930's the traffic on the highways had increased to such an extent that it was necessary to initiate a program for increased lane capacity. The early programs consisted of widening the existing two-lane roads to three-lane highways which was considered a standard in the early 1930's. As the traffic increased, the natural progression from the three-lane highways to a four-lane divided highway was developed. However, roadside development soon started along these routes with resulting conflict of vehicle movements, congestion, increased accidents, and reduced capacity.

In the Biennial Report of 1936 attention was drawn for the first time to a means of providing greater capacity and relief from congestion. This method contemplated the application of restriction of access from abutting property and was the forerunner of the freeway principle in California. In subsequent years further studies and discussions were carried on by Mr. Grumm as Engineer of Surveys and Plans, and with the assistance of the late Mr. C. R. Montgomery, proposed legislation was drafted which finally culminated in the adoption by the Legislature of the California Freeway Act in 1939.

Another development in the design of highways was made while Mr. Grumm was the Engineer of Surveys and Plans. The Research Department had constructed a test track and were gathering information pertaining to the supporting power of highway bases and surfacings in which the test procedure now known as the California Bearing Ratio was developed. For structural design purposes, studies

Fred Grumm on reconnaissance trip in San Gabriel Mountains in 1925



were initiated to correlate the bearing ratio test procedure and the axle loads produced by highway traffic.

The result and conclusions of the studies was published in the Public Works magazine in November, 1941, and a further amplification in March, 1942. These articles detailed the methods to be used in the structural design of highways. The details of the application of the accumulated data were principally the work of A. M. Nash, now District Engineer in District I, who at that time was in Surveys and Plans. This made the State of California one of the first to put the structural design of highways on a scientific basis.

When this photo was taken Fred Grumm (on right) was on survey trip in Kings River Canyon

Active in Freeway Development

The introduction of the freeway principle to the highways of California was new and revolutionary as people had always had access to traveled roads. This access was accepted as customary and a right. It was therefore necessary to undertake the freeway program carefully and slowly. The discreet application of the freeway principle to our highway improvement produced only a few examples of freeways before progress was halted by the war.

One of the first projects of this kind in California was the Arroyo Seco Freeway in the Los Angeles area. Due to the topographical features and the limited amount of property affected, it was possibile to complete a section of this freeway with a minimum of publicity in order to demonstrate its benefits to the highway users. Immediately its popularity was strikingly evident.

During the war years the planning of freeway projects became an important part of the highway work and, in the few years since the war, it has been possible to construct many miles of new highway using the freeway principle. It is Mr. Grumm's opinion that advancement along this line is indicative that we are making progress toward the ultimate in transportation.

Mr. Grumm recently prepared and presented a paper on freeways to the American Society of Civil Engineers in which he discussed the development, benefits, and future of highways constructed upon the freeway principle. This paper summarizes in a few words the primary considerations which are now evident as the result of many years of study on freeway planning. This paper was published in the March-April, 1950, issue of the *California Highways and Public Works* magazine and will be in *Civil Engineering*, the popular journal of the American Society of Civil Engineers.

Throughout his entire service with the State Mr. Grumm was active in an administrative capacity with the Highway Department in the development of planning programs and policies. He represented the Division of Highways for many years in legislative matters. During the war, several weeks were spent studying the organization and efforts of the Bureau of Governmental Requirements—a bureau in the War Production Board—with Mr. Maury Maverick, Chief. This study culminated in a report to Mr. Maverick concerning the "Procedure, Certification and Priorities of Highway Projects." His recommended procedure was later adopted by the board.

One of his latest major efforts for the Division of Highways was his participation in the establishment of an expanded organization and procedure for handling the large increase of work made possible by the enactment of the recent Collier-Burns law.

Mr. Grumm has been a member of many engineering and professional organizations which include membership on the Special Committee on Design Policies of the American Association of State Highway Officials, in which he has been active since its organization; membership on the Committee on Highway Capacity and Economics of Highway Design of the Highway Research Board; American Road Builders Association; American Congress of Surveying and Mapping; the American Society of Civil Engineers (member, 1936), of which he is a past president of the Sacramento chapter; American Concrete Institute; the California State Employees Association, of which he is a charter member; the Commonwealth Club of California; the California Historical Society, E. Clampus Vitus; the American Philatelic Society, and the local Sacramento Stamp Club through which he has received awards at various exhibits; Sutter Club, Sacramento.

Mr. Grumm was born in Lyons, Iowa, and was educated in Michigan. He was married in 1911 to Lina F. Watson, and has two sons, Watson J. and Gunther S.

He proposes, during his retirement, to devote time to his hobbies and other interests which he has developed during the years. He advises that he will always be available and glad to give advice on highway engineering to the younger group of highway engineers. He says he feels safe in making this offer since nobody ever wants advice from older people.

No Parking

Visalia Protects State Highway to Preserve Usefulness as Transportation Artery

By EARLE W. TAYLOR, District Traffic Engineer

Officials of the City of Visalia, realizing the serious effect of traffic congestion on community life, recently prohibited parking along almost the entire length of State Highway Route 10 within the city, and thereby relieved an acute bottleneck on this important highway.

Prohibition of parking is no longer unique. It has become a standard prescription for certain traffic ills. The Visalia action, however, is believed without precedent among smaller cities of California in more than one respect. It is also an excellent illustration of vision and courage on the part of community leaders.

Situation in Visalia

Visalia lies eight miles off the beaten path of U. S. 99, but is not spared the headaches of acute traffic congestion, as are many cities so located. Route 10 (Sign Route 198) is the most important of the three state highways passing through the city. It alone carries almost as much traffic into Visalia as the other 18 state and county road entrances to the city combined. Yet serious deficiencies of width still handicap its users. It is advantageously located to serve the city, as it passes through Visalia in a straight line parallel to but only three short blocks from the main business street. A relocation of it to by-pass a congested area would only result in increased travel distance for thousands of drivers.

Mineral King Avenue, as Route 10 is known locally, consists of three different pavement widths. Only the westerly 0.5 mile portion was omitted from the parking restriction, as it is a rural-type divided highway only half width within the city by reason of a recent annexation. Through the 1.85-mile balance of this route within the city, parking is now prohibited. The magnitude of the restriction invoked at one time is one of the unusual features of this case.

Uncommon Aspect

From Mooney Boulevard easterly for 0.4 mile this street is a modern four-lane, divided highway with curbs and paved parking strips. Prohibition of parking along such a highway through a sparsely developed area of mixed residential and commercial structures, well in advance of acute need, provides another uncommon aspect. City officials appreciated that even along a four-lane highway parking is undesirable in that each parking maneuver interferes with the free use of the outer lane. They realized that elimination could be secured with much less opposition, if proposed before parking became extensive.

Farther east exists a 0.3 mile section of four-lane, undivided highway paved 61 feet wide between curbs and bordered by both business structures and dwellings. The remaining 1.15 mile section to the easterly city limit is paved full width but is only 46 feet wide between curbs. Roadside development is a dense mixture of older dwellings and business structures. It was this narrow section in which relief from congestion was most pressing.

Average daily traffic volumes vary from 7,000 vehicles at the east city limit to about 12,000 vehicles near the heart of the city.

Type of Establishments

Most of the 52 nonresidential establishments on Mineral King Avenue exist along this narrower section. Only 27 percent of them are types, such as service stations, that cause little curb parking. The remainder include, in addition to retail stores, many important establishments providing community-wide services and which generate heavy parking demand.

Although curb parking was not as extensive as in a central business district, parked vehicles were nevertheless spaced close enough to effectively deny moving traffic the use of the curb lane. Only enough pavement width remained for two lanes. When a vehicle performed a parking or unparking maneuver, one lane was blocked to moving traffic. This situation, combined with heavy moving traffic, inevitably resulted in congestion, delay and hazard. The 1949 accident rate in terms of accidents per million vehicle miles was nearly four times as great in this narrow section as through the four-lane portion. The elimination of parking has made four lanes available for moving traffic through the narrow section.

City Officials Act

On such a street, the mere removal of curb parking is not a complete or permanent solution. Soon four, and eventually even six, wider lanes must be provided. A dividing strip must separate opposing traffic and provide a protected storage lane for left-turning vehicles. Access from adjoining property to the through lanes must be restricted. Realizing that such an improvement was still some distance in the future, city officials acted and acted boldly to retard the creeping paralysis of congestion until a modern highway can be constructed.

As the volume of traffic steadily increased, so also did the frequency of complaints regarding delays and hazards received by city officials from owners of adjacent property and users of the street. Some time ago Mayor Jack L. Davis, City Manager E. A. Dunn and other members of the city council started an intensive study of the situation and reached the conclusion that complete elimination of parking was the only answer until the street could be widened. Consultations were held with Division of Highways engineers, who furnished factual traffic data to aid the study.

Next, civic leaders were enlisted and the detailed study was completed as a

Mineral King Avenue in Visalia now is handling a heavy flow of traffic without congestion due to elimination of parking

joint project of these men, the organizations they represented and city officials. The probable effect on each roadside enterprise was carefully evaluated. It was found that for all businesses located on corner lots, ample curb parking space existed on uncongested side streets. Some others already had off-street parking lots and still others had unused space available for such use. Those for which a satisfactory solution was not apparent were few in number.

Support From Organizations

Two men in particular gave great assistance to city officials in developing and putting the plan into effect. Mr. H. T. Lewis, District Manager of the Automobile Club of Southern California, acting in this instance as Chairman of the Highway Committees of both the city and the county chambers of commerce, exerted great influence. Mr. Charles S. Ehrhorn, Chairman of the Tulare County Chamber of Commerce, placed not only the weight of his organization behind the plan but also his own personal prestige as an authority on highway transportation. Mr. Ehrhorn is also Vice Chairman of the Transportation and Highway Committee of the San Joaquin Valley Council, State Chamber of Commerce. These men and others did much to popularize the proposal. Much data was released to the local press regarding the seriousness of the traffic situation and the large benefits to be gained by the parking ban in relation to the small number who would be hurt by it. After the public was more completely informed of the plan, the ordinance was introduced at a regular meeting of the city council.

Prior to the vote, the proposed ordinance was submitted to and approved by the State Division of Highways, and this fact was locally publicized. To operators of many individual establishments recommendations were made. It was pointed out to the pastor of the First Baptist Church that at times of services a free municipal parking lot located less than a block away was being very little used. A subsequent announcement from the pulpit caused a mass changeover from curb to off-street parking. As a result of a similar suggestion the many people attending the almost nightly meetings held in the Masonic Hall now use a nearby municipal lot.

Ordinance Passed

Two weeks later the ordinance came up for hearing and vote, and was unanimously passed. *Not one citizen spoke in protest at either council meeting.*

It is not only the length of the section of street involved that is so noteworthy but also the radical change in situation. Most cities proceed cautiously in such matters. They move progressively but slowly from unrestricted parking to time limit parking, then to peak hour prohibition, arriving at long last at complete prohibition of parking at all times. Officials of Visalia, however, acted more boldly. They changed this street in one drastic move from unrestricted parking to complete elimination of it, because the need for taking this step was so apparent.

Soon after passage of the ordinance, an unexpected phenomenon was observed. Although the restriction could

... Continued on page 43

A Treatise

Experimental Use of Lime for the Treatment of Highway Base Courses

By ERNEST ZUBE, Associate Materials and Research Engineer *

INTRODUCTION

From the earliest times, both the builders and users of roads have recognized that there are vast differences in the character of soils and in their native suitability for highway purposes.

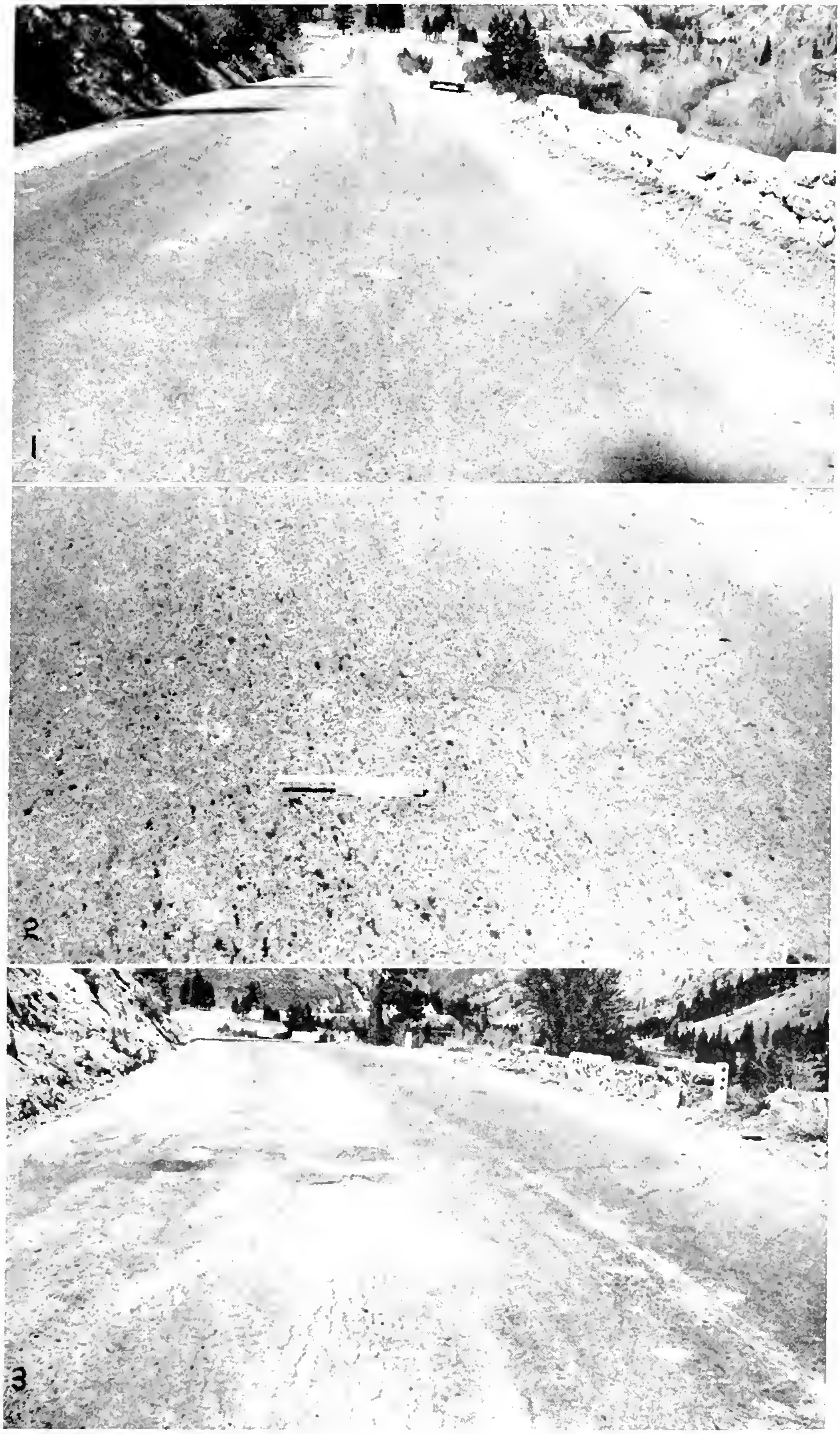
The highway engineer is fortunate when stable soils are encountered or where good granular base material is cheaply available. However, the cost of importing suitable materials and the problems of correcting weaknesses in existing roads have caused many engineers to consider means for improving the properties of whatever soil is encountered. Such artificial treatments are generally referred to as "soil stabilization" and a great many processes including the use of natural and artificial additives have been proposed and tried out.

Clay Soils and Sand

Clay soils have been stabilized by admixing with sand and sands have been improved through the addition of clay binders. However, it is very difficult to achieve an entirely satisfactory balance. Artificial binders such as asphalt, Portland cement, calcium chloride, etc., have been used with varying degrees of success.

One of the most useful road building materials is natural limestone which has long been highly regarded for its stable and enduring qualities. It has also been observed that soils are rendered more friable and their properties of stickiness and plasticity reduced by the admixture of finely ground limestone or hydrated lime. Therefore, the possibilities of improving native materials by the admixture of finely divided lime have been investigated in several areas.

* Prepared for the Committee on Lime Soil Stabilization of the American Road Builder's Association Meeting at Cincinnati, Ohio, March 6, 7, 8, and 9, 1950.



TOP Section treated with 2 percent lime in August, 1948. Photo shows appearance in April, 1949. CENTER—Closeup of same section. LOWER—Failed section not treated with lime. This section was in satisfactory condition in August, 1948, but failed during the following winter

Experiences Elsewhere

Experiences with lime treatment have been reported from the State of Texas and elsewhere and experimental work has been conducted in the Materials and Research Department of the California Division of Highways in order to determine the relative effectiveness of lime treatment. While the results of laboratory experiments indicated that many poor materials were improved by the addition of lime, it also appeared that the cost of commercial hydrated lime was somewhat greater than the cost of Portland cement, for example, and it was not evident from laboratory tests or from reports of field experiments that the lime treatment was necessarily superior to that obtained with Portland cement.

During 1948, an opportunity was afforded to construct two experimental sections in State Highway District III, headquarters at Marysville, California. A supply of agricultural waste lime was available in bulk quantities from the Diamond Springs Lime Company near Placerville, California, at a price considerably less than that of Portland cement and this lime was used on one project. On the other project the more expensive commercially available agricultural lime, packaged in 100-pound bags, was used. This report covers the essential details and observations to date on these two projects located in the Sierra Nevada Mountains east of Sacramento in which agricultural lime was added to natural granular base materials for the purpose of decreasing the plasticity and thus increasing the stability and the load carrying capacity.

SYNOPSIS

The first field project is located on Road III-Nev-38-B near Truckee, California, situated in the Sierra Nevada Mountains, at an elevation of about 5,800 feet, a few miles west of the Nevada State Line. This project was constructed in August, 1948. Two percent of agricultural lime of the type sold commercially in 100-pound bags was added to a four-inch layer of granular base material by the road-mix method. After spreading and compacting, the treated base was covered with three inches of bituminous surfacing. The cost of the lime used was roughly comparable in cost to a similar treatment with Portland cement. Thus far, the treatment appears to be successful.

The second project is located on Road III-ED-93-B, between Cool and Georgetown. This section is located on the western slope of the Sierras at a lower elevation than the Truckee proj-

4—Spreading the untreated base rock. 5—Spreading agricultural bulk lime. 6—Mixing with pulvomixer and blade

ect. Work was started in October, 1948, but was only partially completed that year due to inclement weather. Bulk agricultural lime was obtained from reject piles at the Diamond Springs Lime Company in Placerville and was added to the base material in amounts equal to 4 percent by weight. A light penetration treatment of asphaltic oil was applied as a wearing course. This lime treatment represented a saving of approximately 35 cents per ton of soil treated when compared to a similar treatment using Portland cement.

Both projects were inspected by representatives of Headquarters Laboratory in 1949 and again early in 1950 and it was found that the stabilized base material was giving satisfactory service in each case with little or no evidence of distress after being subjected to comparatively heavy traffic through at least one full and one partial winter season, the winter of 1948-49 was characterized by the heaviest snowfall and the lowest temperatures occurring in this locality. Samples of the lime treated base material taken from both jobs showed it to be nonplastic when tested.

In the spring of 1949 when first inspected it was observed that adjacent areas on both projects where the base material was not treated with lime gave evidences of marked deterioration during the previous winter.

TRUCKEE JOB

A short experimental project using lime as a stabilizing agent in the base material was constructed by maintenance forces during the month of August, 1948, near Truckee on Road III-Nev-38-B, between Bocca and Sierra County Line.

After the spring of 1948, four sections of the road located between stations 180 and 368 and ranging in length from 700 feet to 1,400 feet had become distorted, due to base failure, to such an extent that major repairs were necessary. Material from an existing stockpile on the roadside (Test No. 48-3239) which was proposed for use as base showed a Plasticity Index (P. I.) of 12 when tested. The addition of 2 percent lime rendered this material

7

8

9

7—New six-inch base material with penetration oil treatment. Placed November, 1948. Appearance in April, 1949. 8—Closeup of same section as above. 9—New six-inch base material which went through winter without oil treatment. Appearance in April, 1949

nonplastic. It was therefore decided to use this lime treated aggregate for the new base.

During construction operations the old bituminous surface was salvaged insofar as possible. On Sections 1 and 2, the existing base was removed and wasted and replaced with sufficient new base material from the above stockpile for a layer approximately four inches thick. For Sections 3 and 4 it was decided to scarify and treat the existing base material. Two percent by weight of bagged agriculture lime was then added to the base material on all four sections. (*See Table I.*)

TABLE I

Section number	Length, feet	Treatment
1 (W. end)	1,440	2% Lime, new base material, 14′ wide treated
2	700	2% Lime, new base material, 24′ wide treated
3	1,050	2% Lime, existing base material treated, 12′ wide
4 (E. end of job)	700	2% Lime, existing base material treated, 20′ wide

The material was mixed with a motor patrol, water added as required, then spread with a blade and compacted with a roller. The old surfacing, after some reprocessing, was relaid to a thickness of 2 inches to 2½ inches and topped with a thin blanket of new SC-3 plant mix ½ inch to 1 inch thick, providing a total bituminous treated surface thickness of approximately 3 inches.

Type of Lime

The lime used on this job consisted of commercial agricultural lime with about 85 percent passing the 200-mesh sieve and was supplied in 100-pound paper bags. The initial cost of the lime was approximately $20 per ton f.o.b. Placerville and including the freight to Truckee the cost was about $23.50 per ton. It was obtained from the Diamond Springs Lime Company near Placerville. For the purpose of comparison, the cost per sack of cement in Truckee is approximately $1.25 or $26.50 per ton, based on small quantities.

Tests made on three samples of the lime-treated base material taken from the road on October, 1948, about two months after construction, showed the material to be nonplastic with R Values * of 83 and 84. Three additional samples were obtained in April, 1949. One from Section 1 where the new base material was used, one from Section 4 in which the existing base material was treated and one from a failed area (not lime treated, adjacent to Section 4) which should represent the existing base material prior to stabilization with lime; this failed area was in satisfactory condition in 1948. The two lime treated base materials proved to be nonplastic with R Values of 85 and 86. Tests on the untreated base material showed a P. I. of 18 and an R Value of 67. (*See Table II* for test results.)

CONCLUSION

An inspection on April 20, 1949, of the four stabilized sections constructed in August, 1948, showed them to be in good condition. Samples of the treated base material were nonplastic and when tested in the stabilometer gave satisfactory R Values. The sample taken from an area showing distress and adjacent to one of the stabilized sections showed a Plasticity Index of 18 and an R Value of 67, both of which are considered unsatisfactory for a base material. This area was in satisfactory condition in August, 1948, but failed during the following winter.

* R Value = Resistance value of the soil as determined in the Stabilometer. See "The Factors Underlying the Rational Design of Pavements" by F. N. Hveem and R. M. Carmany, Proceedings of the Twenty-eighth Annual Meeting of the Highway Research Board, December, 1948.

TABLE II

TEST RESULTS OF SAMPLES

III-Nev-38-B

Date sampled	Test number: U No.	Aggr. Dept. No.	Dist. No.	Treatment	Grading % Pass: 3/4	#4	200	5 u	1 u	P.I.	R Val	Density lbs. cu. ft.	Remarks
7/21/48	....	48-3239	.....	CRB - None	88	48	12	3	1	12			Mystic Pit Material
				2% Lime added						NP		--	Preliminary sample
				4% Lime added						NP			
				2% Cement added						3			
				4% Cement added						NP			
10/7/48	540	48-4540	R-2-X	2% Lime added	82	49				NP	83	120	Sampled from roadbed
10/7/48	541	48-4541	R-3-X	2% Lime added	84	50				NP	84	120	Sampled from roadbed
10/7/48	542	48-4542	R-4-X	2% Lime added	80	46				NP	84	121	Sampled from roadbed
4/20/49	1,027	49-2412		2% Lime added (Section 1)						NP	85		Sampled from roadbed
4/20/49	1,028	49-2413		2% Lime added (Section 4)						NP	86		Sampled from roadbed
4/20/49	1,029	49-2414		No lime treatment						18	67		Sampled from failed area

The preliminary test indicated that the addition of 2 percent of cement reduced the P. I. to 3. It is quite possible that by adding 2.0 to 2.5 percent cement to the base material results similar to that of the lime treatment could have been obtained. Due to the high price of the bagged lime ($23.50 per ton) no significant savings over cement treatment was achieved. However, the lime treatment showed satisfactory results and produced a stable base which has carried comparatively heavy traffic during one of the wettest winters in that locality.

A recent inspection, made in February, 1950, showed that the lime-treated sections continue to be in excellent condition.

GEORGETOWN JOB

The second project comprised the construction of a test section which consisted of imported base material to which was added approximately 4 percent hydrated agricultural lime on Road III-ED-93-B between Cool and Georgetown. The work was started in November, 1948, but had to be discontinued due to inclement weather. The project was completed in the spring of 1949.

The old surfacing over the entire section consisted of penetration treatments or road-mixed blankets which were placed at various times since the road had been taken into the State Highway System in 1933.

Portions of the section had become very badly distorted and disintegrated and it became apparent that it would be impossible to maintain the section within the realm of routine maintenance and therefore remedial measures were required to correct the existing conditions in order to carry the increasingly heavy traffic.

Weakened Base Restored

It was proposed to restore and recondition the weakened base at various locations, the areas ranging from 16 feet to 18 feet in width and from 100 feet to 2,400 feet in length, with a local crushed limestone, treated with agricultural hydrated lime and to apply a penetration treatment over the areas thus repaired.

10—Failed section which was not treated with lime. This section was in satisfactory condition in October, 1948, but failed during the following winter. 11—Appearance in March, 1950. (Compare this with photo No. 7.) 12—Closeup of same section (compare with photo No. 8).

The imported borrow material consisted of a waste crushed limestone mixed with some overburden and was obtained from the California Rock and Gravel Company (Crego Plant) near Cool.

Preliminary laboratory tests indicated that the material would be satisfactory for use as base rock with the exception of the Plasticity Index (P. I.) which showed a value of 9. The California Bearing Ratio was 100+ at 0.1 inch and 0.5 inch penetration, and the expansion was 0.4 percent. In order to reduce the P. I., tests were made adding small percentages of cement and agricultural lime to the material and

On most of these portions the base material was placed directly in two courses, each 3 inches thick, upon the old surfacing. In a few cases, the existing thin surfacing and base was scarified, then recompacted, and only 3 inches of new base material was placed. *Table III* shows the thickness placed and the condition of the first 11 sections as of April, 1949.

Nature of Work

In general the work consisted of spreading base material sufficient for a 3-inch thickness and 18-foot width by means of a spreader box on one-half width of the roadway. The lime,

tration treatment of one-fourth gallon per square yard of SC-3 oil was then applied to four sections and covered with fine material obtained from the same stockpile as the base rock. Due to inclement weather the oil treatment for the other seven sections was not applied until the spring of 1949.

The daily traffic observed during construction operations consisted principally of passenger cars, a few pickups, and perhaps about 20 heavily loaded lumber trucks. The right half (easterly side) only of the road is subjected to the loaded lumber trucks which return empty on the opposite side.

TABLE III

III-Ed-93-B

Section number	Length, feet	Location distance miles from Cool	Thickness of base as placed with surface treatment as of April, 1949		
		0 00	Maintenance sign at junction routes 93 and 65 at Cool		
11	2,450	2 60	3'' base placed November, 1948, no oil treatment		
			3'' base to be placed May, 1949		
10	516	3 38	6'' base		No oil treatment
9	350	3 53	3'' base		No oil treatment
8	200	4 15	6'' base	One continous section	Penetration oil treatment, 1948
7	150		3'' base		Penetration oil treatment, 1948
6	600		6'' base		Penetration oil treatment, 1948
5	600	4.65	6'' base		Penetration oil treatment, 1948
4	280	5 35	6'' base		No oil treatment
3	200	5.59	6'' base		No oil treatment
2	600	5 75	6'' base		No oil treatment
1	400	6 60	6'' base		No oil treatment
			(All oil treatments were completed in May 1949)		

the resulting tests showed that the material was rendered nonplastic by the addition of 4 percent of cement or lime. As the agricultural lime could be obtained at a very reasonable cost from the Diamond Springs Lime Company near Placerville, it was decided to use the rock base material with the addition of 4 percent lime.

Day Labor Project

A day labor allotment in the amount of $20,000 was issued to cover the cost of the work. This was sufficient to place about 6,700 tons of treated base material. The first unit undertaken in November, 1948, consisted of 11 portions, ranging from 150 feet to 2,400 feet in length and requiring a total of approximately 4,500 tons of base material with 3,700 tons actually placed during November, 1948. Sections 12 and 13 were constructed during 1949.

which was hauled in bulk by truck from Diamond Springs, a haul of approximately 22 miles, was spread by means of a Buckeye spreader box. The lime was rather damp, showing a moisture content ranging from 25 to 40 percent. Including the moisture content the percent of damp lime added ranged from 5.0 to 5.5 percent by weight. The mixture was then bladed into a windrow along the edge of the pavement until ready for mixing which was usually started the following day, or as soon as time permitted. The mixing was accomplished with the aid of a pulvomixer and a motor patrol and four to six passes were generally sufficient to thoroughly mix the materials. It was then laid out with the blade and compacted with a roller. A water truck was on hand for sprinkling if it appeared necessary. The second course was laid in a similar manner. A pene-

Cost Comparison

Due to the numerous short sections, 11 in all, which required frequent turning of the equipment, the narrowness of the road, nonavailability of a detour, delays due to inclement weather, etc., it is rather difficult to present an accurate cost comparison; therefore, no detailed cost records of the individual operations were kept on the job. According to Maintenance Superintendent E. Willis of Placerville, the total cost of placing the rock base in November, 1948, including the lime but exclusive of oiling operation, amounted to $2.56 per ton. However, by making certain assumptions the cost of the lime stabilization can be fairly accurately estimated. This extra expense involves the cost of the lime, hauling, spreading and mixing operations.

Cost of lime at Diamond Springs (wet)	\$3.50
Sales tax at 2½ percent	0.09
Haul 22 miles at \$0.10	2.20
Cost of lime at job per ton (wet weight)	\$5.79

Assuming an average moisture content of 30 percent for the lime, the cost per ton of dry lime is:

Cost per ton dry lime FOB Placerville \$3.50 x 1.30 =	\$4.55
Cost per ton dry lime at job \$5.79 x 1.30 =	\$7.52
Cost per ton of untreated rock delivered to job site was approximately	\$1.54
Cost of lime per ton of aggregate (0.04) (7.52) =	\$0.30
Cost of spreading and mixing the lime per ton of aggregate was estimated to cost	\$0.25
Total cost of the lime treatment per ton of aggregate was equal to 0.30 plus 0.25 =	\$0.55

from \$3.50 to \$4.50 per barrel in Placerville, a price of \$1 per sack is assumed and assuming a cement content of 2½ percent the cost of the cement per ton of aggregate would be:

$$\frac{(2{,}000)\ (0.025)\ (\$1)}{94} = 53.2¢, \text{ say } \$0.53$$

The cost of 4 percent of dry lime per ton of aggregate is:

$$(0.04) \times (\$4.55) = 18.2¢, \text{ say } \$0.18$$

On the basis of the above comparison, the saving amounts to about (\$0.53 − \$0.18) or \$0.35 per ton in favor of the waste agricultural lime.

a few loads of rock. By visual inspection this material appeared inferior and the use of material from this portion of the stockpile was discontinued. In general, the untreated base material appeared to be of fair to good quality. Tests made shortly after the addition of 4 percent lime (dry weight) showed a lower P. I. or nonplastic material. The four samples obtained in April, 1949, had a plasticity index of zero.

Base Course

The base course, either 3 inches or 6 inches thick (in most cases even without any bituminous surface treat-

TABLE IV

PRELIMINARY SAMPLES

III-ED-93-B

Date sampled	Test number: U No.	Test number: Aggr. Dept. No.	Test number: Dist. No.	Treatment	Grading % Pass: ¾	#4	200	5u	1u	C.B.R.: 0.1″	C.B.R.: 0.5″	PI	R Val.	Den. wt. cu. ft.	Thickness reg.	Remarks
July, 1948		48-3070	R-1-E	None	79	46	21	5	2	131	136	9				
	404	A		2% cement						497	287	9	80-90	137	0	
		B		4% cement						767	473	NP				
	404A	C		2% lime						218	192	8	77	136	3.5″	
		D		4% lime						397	265	NP				
		E		3% cement								7				
		F		3% lime								6				
	405	48-3071	R-2-E			100	21									Agricultural lime used in test 3070
Oct., 1948	524	48-4474	R-2-E	None	79	43	17	6	3			7	76	140	4″	
	524A			4% lime									82	132	2	
	525	48-4475	R-3-E	None	80	43	17	6	3			7	77	138	3.5	
	A			4% lime									82	133	2	Lime U 530
	B			2% cement									95	135	0	
	C			4% lime									89	134	1	Lime U 531
	526	48-4476	R-4-E	None	92	52	20	5	2			NP	87	138	1	
	A			4% lime									87	132	1	Lime U 530
	530	48-4496	R-5-E			100	39									Stockpile lime
	531	48-4497	R-6-E			100	85									Bagged lime

The only two ingredients for reducing the P. I. or increasing the R Value of the base material that would have been considered for this job were lime or Portland cement. Generally speaking, the only difference in cost is the initial cost of the material, as the cost of hauling, mixing, spreading and compacting would be approximately the same for both materials.

From previous experience on similar jobs about 1½ percent to 2½ percent of cement is usually sufficient to achieve these results.

With the price of cement ranging

Conclusion

Preliminary samples submitted prior to start of construction showed a California Bearing Ratio in excess of 100, however, plasticity index test results ranged from 7 to 9. Laboratory tests indicated that the addition of 4 percent of agricultural lime would render the material nonplastic. Samples of the untreated rock base taken during actual construction showed a P. I. of 7 and an "R" Value of 77 to 79. Sample No. U 615 (*Table V*) which showed a Plasticity Index of 16, represents only

ment), has stood up satisfactorily during the winter of 1948-49 which was considered one of the wettest. The inspection trip in April, 1949, revealed that the base had hardened considerably and some effort was required to dig holes for test samples, especially in Section 2 in which it was difficult to sink the pick into the pavement. Section 11, which had gone through the winter with only 3 inches of base material and no protective oil treatment, showed some raveling. In Sections 5, 6, 7 and 8 which were completely

. . . *Continued on page 56*

Another Loss

E. Q. Sullivan Joins List of Veteran Highway Engineers in Retirement

Chalk up another loss to the Division of Highways.

E. Q. Sullivan, District Engineer at San Bernardino, joined the growing ranks of veteran state highway engineers in retirement on August 3d after 36 years of distinguished service. He had served for 27 years as District Engineer of VIII, embracing San Bernardino County and the western portion of Riverside County. During that period he directed highway construction costing $75,000,000.

E. Q. Sullivan—1950

Mr. Sullivan was requested to tell in his own words something about himself and his public career as a highway engineer. Here is his interesting narrative:

Born in San Diego

"I was born in 1887 in San Diego and went to San Diego High School, completing high school in 1907. I worked my way through high school carrying two paper routes in San Diego; one route on the San Diego *Union* and one on the San Diego *Tribune*. I also had a job winding the San Diego town clock at $1 per week. The clock was in the courthouse tower and was run by a heavy weight (about 500 lbs.) that had to be cranked up with a hand wrench. I also had a job as "organ pumper" at the First Congregational Church of San Diego at 25 cents per church service.

In the summer of 1907 I went to work on the Santa Fe Railroad working out of San Bernardino as "stake puncher" on a survey party. I planned to go on to the University of California, but I had to work my way through and, therefore, stayed out one year, remaining with the Santa Fe until August, 1908. During this year on the Santa Fe, I progressed from stake puncher to chief of a small survey party. The next summer school vacation I went back to work on the Santa Fe Railroad and was assigned as inspector on construction work. I then returned to the university for another term but had to stay out between the sophomore and junior year for a year to earn enough money to go on through college. That year I worked on the Santa Fe on construction and relocation work. Most of the time I was inspector on construction work, but at times I was in charge of a survey party.

Graduates From U. C.

"Completing my education at the University of California in 1913, I was employed by a private engineer in Los Angeles (long since deceased). I did relatively little work for him, but he placed me on a number of projects that were designed in his office. I went out as construction superintendent to build these projects with day labor forces. One of these projects was the North Main Street Bridge in Riverside which supports a branch of the railroad over North Main Street. This bridge was written up in the *Engineering News Record* a few years ago, and the opinion was expressed that this was the first reinforced concrete bridge for railroad use built in the United States. The article in the *Engineering News Record* asked readers to send in known bridges of earlier date, but no response was received from the readers of the magazine. This bridge is still in place and in excellent condition; State Highway Route 43 passes under it.

Goes to Hollywood

"In the late fall of 1913, I went to work for "Paramount Pictures" which was organized at that time. I acted as their construction superintendent and had daily conferences with the operating heads of Paramount. We conferred for perhaps an hour every day

E. Q. Sullivan—1914

at the studios we were constructing. The operating heads were the well-known Los Angeles capitalist Gabert, the famous actor Bosworth, and Jack London, all now deceased. I grew to know these fine men very well during this period and they did not want me to leave when I went to work for the State the next summer.

"I believe I took the first civil service examination given; it was in the fall of 1913 or spring of 1914. I passed this examination and was offered a job and accepted at about half the pay I was receiving from Paramount. Jim Standley, now Assistant State Highway En-

gineer, also took the same examination and was appointed from the same list. We both went north on the same train, though we did not meet on the train or know each other at that time. We met for the first time when we reported in Dunsmuir on August 3, 1914. I was assigned as assistant resident engineer under Spencer Lowden, who had received an appointment about a year earlier. Spencer had a good previous background of experience as assistant county engineer of one of the northern counties (I believe Shasta County). I was assistant resident engineer to Spencer for about three months and then was appointed resident engineer and was transferred to Tehama County.

"On September 18, 1916, I was married to Rosalind J. Chase. Rosalind and I were in school together from kindergarten through high school. She went on to Occidental College and I went to the University of California, but she took postgraduate work at U. C. in Berkeley during my last year in college. Our honeymoon consisted of a motorcycle trip from Red Bluff to San Diego. It took five days each way in those days to make such a trip. The roads were still mostly dirt roads and motorcycle traveling was not easy. We have two children; Edwin F. Sullivan, who is an engineer in the Reclamation Service, residing in Sacramento, and Jean R. Sullivan, who is Director of Admissions at International House at the University of California, Berkeley. Jean is at present on one year's leave of absence in Europe.

"I stayed in Tehama County for about nine years, being promoted finally to assistant division engineer. During this time, Russ Stalnaker, Jim Standley, Harry Comly and I held the active administrative jobs under Division Engineer T. A. Bedford, a fine person and wonderful leader. The field work was largely in the hands of Harry Comly and myself. I had the south end of the division and lived in Corning and Red Bluff. Standley and Stalnaker were in the Division Office.

THIS PHOTO WILL INTEREST OLDTIMERS

The above picture taken in 1915 or 1916 in Tehama County shows one of the early paving operations with E. Q. Sullivan as resident engineer. The picture is panoramic in showing every detail of the operation.

Note that on the far, left-hand side there is a horse-drawn water wagon to supply the concrete mixer. On the left side the narrow 15-foot width of pavement clearly shows. It looks like one-lane, but it is really the old original two-lane, 15-foot wide Portland cement concrete pavement. The thickness was four inches and the mix was 1-2½-5.

Note next, the hand tamper with a man on each end. A "scratch template" can be seen just in front of the mixer. This was an invention that appeared simultaneously on many jobs. Mr. Sullivan recalls that he put one on the first job he was on as resident engineer to the dismay and surprise of the contractor. The "scratch template" measures the thickness of the concrete pavement by scratching along the subgrade and this equipment was, of course, required on all later contracts. Note the mixer is a steam-engine mixer with a boiler; a real antique.

"I recall," says Mr. Sullivan, "on this particular rig that I insisted that the canvas canopy be placed by the contractor. He was unable to keep a mixer operator on the mixer long enough to learn the job because each one collapsed with the heat. The location was in Tehama County and the time was midsummer with temperatures well over 100 degrees. The operator stood with his back to the boiler under the glaring sun.

"I am seen standing just slightly to the right of the boiler of the concrete mixer. Beyond me and along the subgrade are seen the laborers loading wheelbarrows with gravel and sand which they ran over the subgrade and dumped into the skip of the mixer. The mixer skip is hidden behind the boiler of the mixer."

No Autos for Engineers

"When I first went to work for the State, employees were not permitted to have automobiles in District II. Saddle horses were at first permitted for transportation, and horse and buggies were later provided for resident engineers. The State called for bids and livery stablemen would bid on furnishing a horse and buggy. I recall that I succeeded in obtaining a very beautiful pacer. This animal was reputed to be the fastest horse in Tehama County at that time and was raced every year at county fairs. The animal was a mare named Molly of beautiful chestnut color with a white star on her forehead. Between fairs, she was eating her head off in the stable and the owner of the stable was glad to rent her out to some one person rather than to a succession of "traveling men" who were the usual customers of the livery stable.

In going to work, the roads were dusty and no young engineer worth his salt desired to have anyone pass him on the road. I vividly recall that I quickly learned to take the reins up short, cluck to Molly when anyone tried to pass us, and down the road we would go pacing in a cloud of dust. Early in 1916 I was permitted to have a motorcycle which I had to buy with my own money; this was the motorcycle I used on my honeymoon in 1916. When the motorcycle was used on state business, the State allowed 1½ cents per

mile reimbursement, but I hod to furnish the gas, oil, repairs, and tires. Tires were the principal cost since they only lasted one or two thousand miles.

His Banked Curves

"In the early days, the pavements were 15 feet wide, four inches thick, and 1-2½-5 mix. Superelevation of curves was not permitted (banking of curves). I recall that on an early job on which I was resident engineer I went ahead and banked all the curves without obtaining my authority from the division engineer or from the Sacramento office. The chief engineer was then A. B. Fletcher. County ordinances usually limited the speed of traffic to 25 miles per hour, and this was the case in Tehama County at that time; so, banking of curves was really hardly necessary.

"After the job was finished a big celebration was held and officials came from Sacramento, including the Governor. I was very proud of my banked curves as I had received a good deal of favorable comment from the local people. They were just like the railroad curves with which I had been familiar in my earlier railroad experience. I recall, however, an extremely sharp reprimand, both from the division engineer and the chief engineer, who came to the celebration. I was asked to explain in a formal letter by what authority I had superelevated the curves. It was a tough letter to write to "Headquarters." I remember that I hoped they would fire me; I would then have gone back to Paramount at greatly increased pay. However, nothing came of it. The following year all new contracts provided for banked curves.

New District Created

"In coming to San Bernardino as district engineer on October 1, 1923, I was told by the new chief engineer, R. M. Morton, that the object in creating San Bernardino District VIII was to relieve Los Angeles District VII of the burden of locating and constructing the interstate connections to Southern California. At that time U. S. 66, U. S. 60, and U. S. 80 were the three interstate connections. (U. S. 91 had not then been added to the State Highway System.)

"There were no accurate maps of the vast desert region between Las Vegas and Yuma, and my first years as district engineer were spent in intensive study of routing locations for these interstate connections. The existing roads were practically impassable. The only road that carried any appreciable amount of traffic was Highway 66. This road was two ruts in the sand; where the ground was hard, it was two rows of chuck holes. It required 2½ days to go from San Bernardino to Needles, a distance of 240 miles.

This is old plank road across sand dunes near Yuma to which Mr. Sullivan refers in his article

Road Through Sand Dunes

"A plank road eight feet wide had been built across the sand dunes near Yuma on Highway U. S. 80, but I was instructed to try to find a better solution since this plank road had already grown to be wholly inadequate even for the slight traffic of 1923. The plank road was designed to be raised or lowered to conform to the shifting sand. The maintenance cost was extremely excessive.

"This design was a standard design throughout the world for similar conditions; no attempt had ever previously been made to build a road on permanent line and grade across moving sand dunes. The solution to the problem was found after two years of research. The research consisted of construction of a wind tunnel and a thorough, experimental study of the behavior of moving sand. At the same time, field studies were undertaken and careful observations and measurements were recorded of the sand dune behavior on locations across the dunes. The solution to the problem was a combination of proper alignment relative to prevailing wind direction plus profile elevation relative to height of moving dunes. At that time, there was no literature on this subject, and, for many years, engineers from all over the world visited District VIII to observe this road and to consult on similar problems in their countries. Engineers came from Egypt, Australia, Chile, Peru, and South Africa.

High Cost of Old Road

"Before the construction of the highway on permanent alignment and grade across the sand dunes, the cost of raising and lowering the old plank road had reached $35,000 per year, which was a prohibitive cost for those days. Freedom from sand trouble on the new road saved its entire cost of construction in less than 11 years in addition to giving highway traffic a two-lane pavement on modern standards.

"All of the interstate connections across the desert have long since been located and constructed on modern standards of safe high speed alignment and grade. These desert connections consist of about 800 miles of desert roads from Southern California to Las Vegas, to Needles, to Blythe, and to Yuma.

"I have been district engineer in District VIII ever since 1923. San Bernardino District Headquarters is in the populous metropolitan area only 57 miles from the center of Los Angeles City. The district boundary is half-way between the center of Los Angeles City and the center of the City of San Bernardino so that the problems of District VIII have also included heavy metropolitan traffic out of Los Angeles, as well as the long desert routes. Recent

. . . *Continued on page 57*

Hollywood Freeway

By FRANK B. CRESSY
Assistant District Engineer—Construction

THE HOLLYWOOD FREEWAY is often considered as the most important freeway in the Metropolitan Los Angeles Freeway System. It is 10 miles long, extending from Spring Street in the Los Angeles Civic Center northerly to Vineland Avenue in the San Fernando Valley. The 1½-mile unit from Highland Avenue to Barham Boulevard, then known as Cahuenga Freeway, was completed in 1939 under a Los Angeles city contract, financed with city, federal and state highway funds. Further construction on this important freeway was delayed until additional state funds could be provided, as was done by the Collier-Burns Highway Act of 1947.

With additional financing made available, most of the required right of way has been acquired and cleared, and considerable construction has been completed or is now in progress under state contracts on the Hollywood Freeway. The two-mile section extending from the Cahuenga Freeway northerly between Barham Boulevard and Vineland Avenue was completed two years ago at a cost of $1,500,000. This section included the grade separation bridge to carry the freeway over Lankershim Boulevard.

Four-level Structure

Also completed about two years ago is the unique four-level grade separation structure at the junction point of the Hollywood Freeway with the Harbor Freeway and the Arroyo Seco Freeway. The arrangement at this grade separation structure is such that four separate roadway levels pass or cross one another in a single bridge structure. This results in economy of construction costs. In order to function as a freeway traffic interchange system, the four-level grade separation structure requires in close vicinity what might be called 12 "satellite" bridges.

. . . Continued on page 18

By H. E. BELFORD
Resident Engineer

CONSTRUCTION on the Hollywood Freeway between Glendale Boulevard and Virgil Avenue, a distance of 1.6 miles, was started on June 22, 1949, by the N. M. Ball Sons Company, contractors, and is approximately 80 percent complete.

The work consists of grading and constructing an eight-lane concrete divided highway, separated by a 10-foot central dividing strip, construction of various off and on ramps, outer highways and city street connections, installation of storm drains and sanitary sewers, construction of a reinforced concrete box-section pedestrian undercrossing and various retaining walls, installation of a complete sprinkling system for the entire project, and fencing of the right of way.

Grading operations are now complete excepting for minor cleanup, a total of 500,000 cubic yards of earth having been moved, of which approximately 335,000 cubic yards was waste material which was hauled to the state-owned disposal area along Bishops Road, and the balance used for roadway embankment construction. Wherever possible on the project, excavation and embankment slopes were flattened to 2:1 or better in order to provide for easy planting maintenance.

Heavy Excavation

Construction of the eight lanes of Portland cement concrete pavement 12 feet wide and 8 inches thick, consisting of 18,600 cubic yards of Class "B" concrete, is 100 percent complete. Installation of sanitary sewers, storm drain pipes, storm drain structures, retaining walls and the pedestrian underpass are approximately 95 percent complete at this time.

This work involved 32,000 cubic yards of structure excavation, 2,680 cubic yards of Class "A" structure

. . . Continued on page 19

By HAIG AYANIAN
Resident Engineer

THE ROUTE of the Hollywood Freeway, Road VII-LA-2-LA, from Grand Avenue to Glendale Boulevard, 1.6 miles in length, passes through a densely built-up residential district and across many important city streets. The construction, now in the final stages, connects previously constructed grade separation bridges including the unique four-level structure at the junction of the Hollywood, Harbor and Arroyo Seco Freeways. Considerable work is being done on the various interchange ramps surrounding and leading to this structure. The construction was started on July 12, 1949, by N. M. Ball Sons, the contractor.

At the present time this contract is approximately 70 percent completed. The concrete paving and cement treated base operations are now in progress and are moving along at a rapid rate toward completion. All the underground facilities and installations have been completed as has the roadway excavation. Eight 12-foot wide Portland cement concrete traffic lanes have been completed from the four-level structure westerly. It is anticipated that the contract will be completed by the end of 1950 and well within the specified time limit. The estimated cost of this project is about $996,000 exclusive of engineering.

Design of Freeway

The design of the freeway provides for four lanes on each side of the 10-foot wide division island from the west to Beaudry Avenue Undercrossing, at which point the Hollywood Parkway is reduced to six lanes divided. It has two additional lanes on each side, diverging to form the interchange ramps at the four-level structure. The complex system of interchange ramps is in general composed of two-lane road-

. . . Continued on page 20

On May 4, 1950, the first concrete was poured for the pavement at westerly abutment of Glendale Boulevard grade separation

Continued from page 17 . . .

Including the cost of these bridges, the cost of right of way and the cost of construction, completed or in progress, the four-level interchange system represents an investment of $5,000,000. Grade separation interchange systems as costly as this are justified only where large volumes of traffic must be provided with easy interchange between freeways.

Grade Separations

Between the Los Angeles Civic Center and Western Avenue, the completed construction now includes 22 grade separation projects, and there are three grade separation bridges on which work is in progress. From Western Avenue to Highland Avenue, grade separation construction is now under way at Sunset Boulevard, Wilton Place and Fountain Avenue, and right of way acquisition and clearing is approaching completion. From Western Avenue into the Los Angeles Civic Center, four contracts are now under way for grading and paving. The Civic Center grading contract was described in a previous issue of *California Highways and Public Works* (May-June 1949 issue). The grading and paving contract for 1.7 miles of the Hollywood Freeway from Western Avenue to Virgil Avenue was awarded May 11th to the Griffith Company, and construction on this unit is off to a good start.

Exceptional progress is being made by N. M. Ball Sons, the contractor on two adjoining units of the Hollywood Freeway, totaling 3.6 miles in length. On the first of these units, from Grand Avenue to Glendale Boulevard, Mr. Haig Ayanian is the resident engineer. On the second unit, from Glendale Boulevard to Virgil Avenue, Mr. H. E. Belford is the resident engineer. In this same issue of *California Highways and Public Works*, progress reports on these two contracts have been made by the resident engineers.

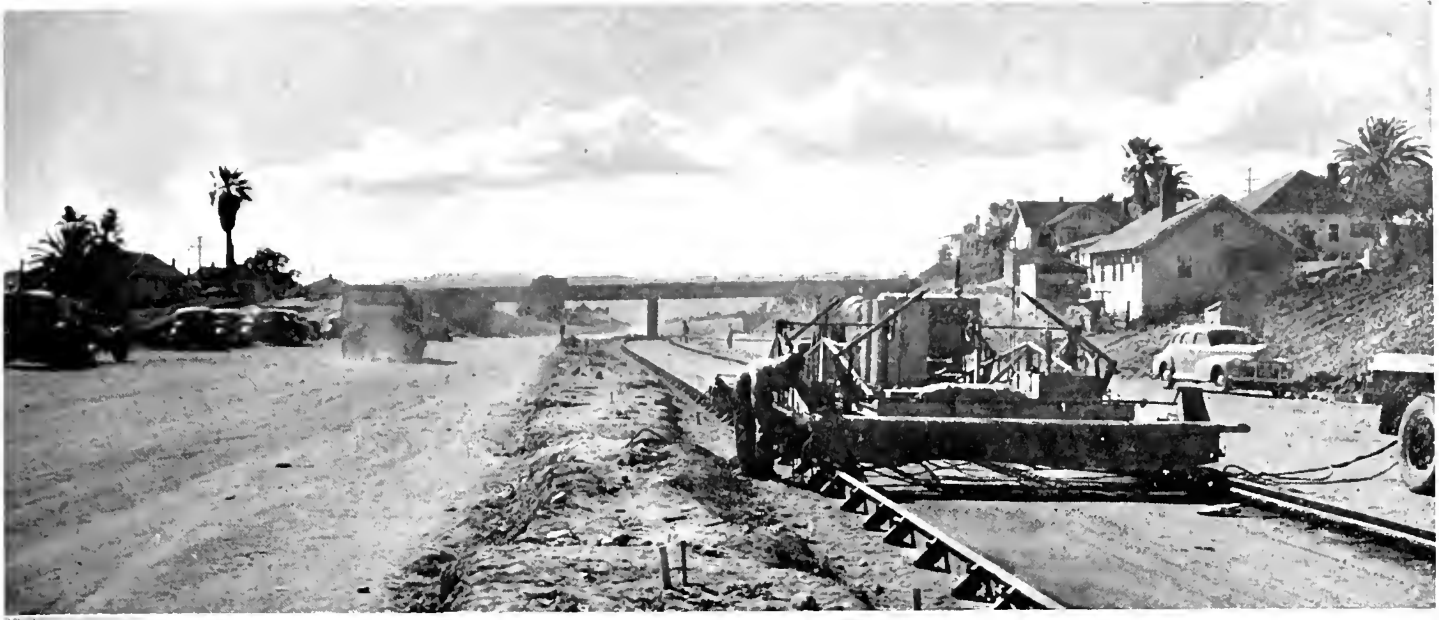
Many Economies Effected

Because of the fact that the same contractor was low bidder and was awarded the contracts for these two adjoining units of construction on the Hollywood Freeway, many economies of operation have been worked out and much better progress toward completion has been made than if the work had been handled by different contractors. The grading work, the cement treated base construction and the paving operations were carried out as if these two units were one contract. The identity of these two units has become a matter of bookkeeping only, since the same construction crew and the same engineering supervision force are being used for carrying out these operations without regard for the line of demarcation between the two contracts. As of this date, all eight lanes of the main freeway pavement have been completed on both contracts between the four-level grade separation structure and Virgil Avenue.

First Concrete Poured

On these two construction contracts, May 4th was a historic date. On that day the first bucket of Portland cement concrete was placed in the pavement at the westerly abutment of the Glendale Boulevard grade separation bridge, with the concrete paving operations proceeding in a westerly direction. The dramatic moment when the first bucket of concrete spilled onto the subgrade was pictorially recorded by a photographer of the Los An-

. . . Continued on page 45



UPPER—Looking westerly along the Hollywood Freeway with the Bonnie Broe Overcrossing in background. LOWER—Looking westerly along the Hollywood Freeway under the Benton Way Overcrossing

Continued from page 17 . . .

concrete, installation of 11,630 linear feet of concrete pipes of various sizes up to 60 inches, and the laying of 3,390 linear feet of sanitary sewers. Construction of PCC curbs, rolled gutters and miscellaneous sidewalk is in progress and approximately 60 percent complete.

Sixty thousand tons of imported subbase material have been hauled in from the state stockpile on the Bishops Road disposal area and placed on the roadbed, ramps and outer highways, in varying depths of 1.0 to 1.33 feet. About 70,000 tons of decomposed granite imported base material have been hauled in from the Hollingsworth Pit in the Griffith Park area along the Los Angeles River and placed in the imported subbase material to a compacted thickness of 8 inches.

Pavement Design

The top 4 inches of the imported base material under the 8-inch Portland cement concrete pavement on the main freeway was cement treated with 3.5 percent cement, and tests on this material show compressive strengths in seven days varying from 495 pounds to 896 pounds, and an average relative compaction of 98 percent.

The cement-treated subgrade for Portland cement concrete pavement was road-mixed beween the side forms. Pavement side forms were first set to line and grade and the subgrade cut to proper elevation with a Lewis subgrader pulled by a D-8 tractor, following which the subgrade was scarified to the proper depth for 4-inch treatment, the material windrowed and the cement induced with a Simball combination scarifier-windrow sizer-cement proportioner machine operating on the side forms and also pulled by the same D-8 tractor.

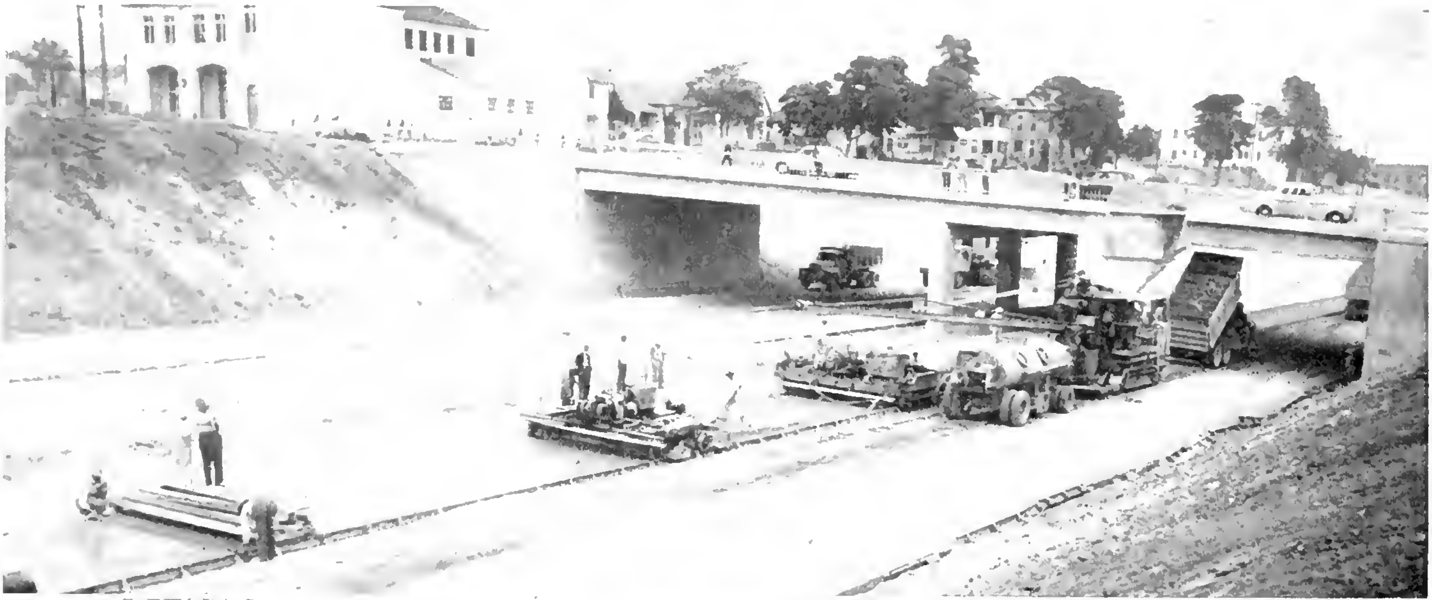
The material was watered and mixed with a Woods model 54 mixer and spread with a homemade drag, this equipment being pulled and operated by the second D-8 tractor. The material was then rolled with two 12-ton 3-wheel rollers and then cut to within one-eighth inch of finished subgrade elevation with another Lewis subgrader pulled by the No. 2 roller when making its last pass. A pneumatic-tired roller attached to the rear of a 500-gallon water truck was used for the final rolling, this truck furnishing any necessary water needed in order to secure a tight finish on the material.

Mixing type 60-70 emulsion was applied at the rate of 0.18 gallon per square yard direct from a small distributor truck for the cure seal. With the above equipment operating in a continuous train, the elapsed time between first scarifying the material and final rolling averaged 30 minutes, which was reflected in the high compaction and 7-day strength tests.

Will Be Completed in October

Pavement concrete was batched on the project and hauled by trucks to the mixer. A Koering 37E twin-batch

. . . Continued on page 53



UPPER Portland cement concrete paving operations at Edgeware Road Overcrossing. Looking east with fire station on left. LOWER—Portland cement concrete paving operations as viewed looking west from the Edgeware Road Overcrossing

Continued from page 17 . . .

ways. Acceleration and deceleration lanes are provided where needed.

In addition to work performed on the freeway proper, it is necessary to do extensive work on neighboring and abutting streets. Some of the lesser important streets are dead-ended at the freeway right of way. In one instance a pedestrian undercrossing was constructed. Grand Avenue presented a difficult problem due to the fact that it rose abruptly over the west side of Fort Moore Hill, between Temple Street and Sunset Boulevard. Inasmuch as entrance and exit ramps are to connect to Grand Avenue, it was necessary to lower the grade of this city street so that ramp grades would not be excessive.

The design called for placing of 8 inches of imported subbase material from a stockpile previously excavated from Fort Moore Hill under a prior

UPPER—Placing Portland cement concrete pavement on cement-treated subgrade. At Edgewore Road looking south toward Temple Street. LOWER—Portland cement concrete paving operations looking easterly at Edgewore Road Overcrossing

contract, and stockpiled at the Bishops Road Dump. An 8-inch layer of imported base material was placed over this subbase, and the top 4 inches of this material was cement-treated where Portland cement concrete pavement was to be placed. Acceleration and deceleration lanes consist of 4 inches of asphalt concrete pavement on 6 inches of cement-treated base, on 6 inches of imported base material under which there is 8 inches of the imported sub-

base material. Approximately 110,000 tons of these materials were hauled in from sources as far as nine miles away.

Traffic Cared For

Because of acute traffic conditions, the lowering of Grand Avenue was set up in the special provisions as the first order of work to be completed before any other work could be started, and public traffic was to be carried through the construction. During the morning and evening rush hours, a large volume of traffic moves over this street that is an important Los Angeles city traffic arterial. The maximum cut at the crest was approximately 16 feet and was made one-half width at a time. The underground work was extensive, requiring the construction of a new sanitary sewer system, new storm drain structures, changes in gas and water mains and telephone conduits. It was also necessary to build concrete retaining walls, stairways, and to adjust abutting properties to the new lower grade. The reconstructed street was surfaced with 8 inches of asphalt concrete. It is interesting to note that one of the old pavements uncovered and removed consisted of granite paving blocks set on an asphalt cushion. All the work of reconstruction of Grand Avenue has been completed.

Roadway Excavation

The roadway excavation on this contract, consisting of 290,000 cubic yards, was performed by conventional methods with heavy grading equipment. The only difficulty encountered by the contractor was the removal of massive concrete building foundations remaining after completion of right of way clearing operations. These were dozed out and broken up by means of an Emsco pavement breaker, and hauled to the state-owned disposal area at Bishops Road.

Most of the material excavated was a silty shale which offered no difficulty to being loaded and hauled by means of DW-10's, Tournapulls and carryall scrapers. The cuts were designed for cuts varying from 4:1 to 1½:1. The embankments were constructed by the usual methods, except a portion of the rolling which was done by a Caterpillar, DW-10, rubber-tired tractor unit converted so that the rear wheels consisted of the drums from a small sheepsfoot roller. This conversion was made on the job. Additional weight was placed over the rear axle so that the resulting load on each tamper foot was 265 psi. This roller was able to make almost three times as many trips per hour as the usual tractor-drawn roller, and the cost of this unit was considerably less than the conventional rig. The embankment slopes were designed for a minimum of 2:1, but in some areas where right of way was available, the slopes were flattened out to facilitate maintenance and to use as much of the excavated material as possible.

Seepage Overcome

A portion of the area around the four-level structure had been graded under the original bridge contract, and the area between this structure and Sunset Boulevard showed evidence of seepage in several locations. This was remedied by means of tile underdrains placed to intercept the seepage above the roadway and drain it into the storm drain system. When the trench was opened up under the Sunset Overcrossing a large flow of water was encountered. A 2½-inch pump just kept the water level constant for the first day, and then gradually drained the trench. The cut bank immediately north of the Sunset Overcrossing and lying across the end of the construction on the "A" line on this project, shows extensive seepage along its base. Temporary measures are being taken to lead these waters to the storm drains, and permanent remedial measures will be taken after this bank is removed, on a subsequent contract. The tile underdrains installed on this contract in this area are draining substantial amounts of water, and the roadbed has stabilized.

The existing and new cut slopes were scarified to a depth of six inches to provide for the future landscaping work. The contractor built a scarifier unit which was triangular in shape and had along its base the required scarifier teeth. This unit was fastened to a truck-mounted dragline in lieu of the drag bucket, with the apex of the triangle attached to the dragline cable. The unit was then hoisted to the top of the slope and pulled down, scarifying as it descended. The teeth were spaced closely enough so that the soil was well broken and aerated. The above unit was then modified so as to be placed on the bottom of a D-8 dozer blade. The scarifying was accomplished by running the dozer in reverse, thus not leaving tracks on the scarified areas. There are about 60,000 square yards to be scarified of which about 46,000 square yards have been completed.

Storm Drain System

A complete storm drain system was constructed and integrated with the Los Angeles City system. Approximately 7,000 lineal feet of storm drain pipes varying from 12 inches to 42 inches in diameter were placed along with some 300 cubic yards of Class "C" Portland cement concrete reinforcement. Existing sanitary sewer systems were remodeled and revised to fit the new construction. This work has been completed.

The pavement on the freeway proper and on the interchange ramps consists of an 8 inch Class "B" Portland cement concrete slab. The quantity involved is in the neighborhood of 22,000 cubic yards, of which at this time, more than one-half has been placed using the latest equipment and methods. Production has averaged over 850 cubic yards per eight-hour day. Due to the many bridges and structures to be crossed by the paving equipment, the contractor has evolved an efficient operation in moving. The lost time usually incurred in moving has been reduced to a minimum. The cement treatment preceding the paving operations has moved along very smoothly, as evidenced by the time interval of only one-half to three-quarters of an hour from the time the water is added until the final rolling takes place. Excellent results have been obtained so far as shown by relative compactions and compressive strength tests.

Erection of the 6-foot chain link fence along the right of way of the freeway has been started and is proceeding at this time. The contractor was forced to start his fencing operation earlier than usual in order to keep construction areas clear of privately owned automobiles parked for the

. . . Continued on page 23

NEW UNIT OF EAST SHORE FREEWAY IN OAKLAND OPENED

Motorcycle escort leads parade of official cars after dedication of latest unit of East Shore Freeway in Oakland. Hegenberger Road Overpass in background

At 11 a.m. on June 1st, Director of Public Works C. H. Purcell formally opened the latest completed unit of the East Shore Freeway, extending from 23d Avenue to 98th Avenue in Oakland, linking up that portion of the freeway from 23d Avenue to Sixth and Oak Streets.

The plans of the Division of Highways contemplate a freeway from Richmond in Contra Costa County to San Jose in Santa Clara County. The section from Richmond to the San Francisco-Oakland Bay Bridge has been in use for a number of years. The portion from 23d Avenue to Sixth and Oak Streets was opened a year ago.

The total cost of the 22-mile freeway is estimated at $64,000,000, of which 20 percent represents the cost of right of way. Dedication ceremonies held on June 1st under auspices of the Oakland Junior Chamber of Commerce, were staged at the Hegenberger Road Overpass.

Following the tape cutting, a caravan of cars in which rode state, county, and municipal officials, moved over the freeway to 23d Avenue.

Guests introduced at the brief ceremonies included George McCoy, State Highway Engineer; John H. Skeggs, Assistant State Highway Engineer for District IV; B. W. Booker, District Engineer for the State Highway Division; G. L. Beckwith, Director of Construction on the new freeway unit; L. A. Weymouth, District Engineer, and Jack Campbell, Maintenance Superintendent for the State Highway Division.

Director of Public Works C. H. Purcell assisted by Thomas E. Caldecott, Supervisor, 4th District, Alameda County, cuts ribbon to open new freeway to traffic

Others who attended the event included Claire V. Goodwin, President of the Oakland Board of Port Commissioners; William Sparling, new General Manager of the Oakland Chamber of Commerce, and a host of state and civic officials. Among them were Mayor Clifford Rishell of Oakland, City Manager John F. Hassler, Alameda County District Attorney J. Frank Coakley, State Senator Arthur H. Breed Jr., Assemblyman Luther H. (Abe) Lincoln, W. H. Park, President of the Oakland Chamber of Commerce, and city officials from throughout Alameda County.

E. R. Schmidt was chairman of the Junior Chamber Committee in charge of the event. Verne Wallace acted as master of ceremonies.

Hollywood

Continued from page 22 . . .

whole day. The proximity to the civic center of Los Angeles where parking space is hard to find and costly makes any unfenced areas attractive to motorists attempting to park their vehicles. This caused awkward situations to develop when it became necessary to perform work in an area covered by 50 or 60 automobiles. The situation is not to be relieved until the fencing has been erected around the construction areas.

State Fair

Thousands Will Travel State Highways to Attend Big Show

Motorists by the tens of thousands will use the superb highways of California to travel swiftly and safely to the California State Fair, to be held in Sacramento this year from August 31st through September 10th.

Burgeoning with stellar attractions and greater than ever, the 1950 fair, which is destined to top all previous state fairs, will hold an 11-day birthday party to celebrate California's 100th anniversary as a State.

Delivering of the State's charter 100 years ago will be reenacted as part of the opening day ceremonies on August 31st. State officials and Miss Hallie Hensley, of Marfa, Texas, a descendant of a member of the charter party, will be the principal figures in recreating this memorable event.

Birthday Theme

In keeping with the birthday theme, the fair is providing two great cakes. One, made of plaster and measuring 15 feet in diameter and 13 feet in height, will be located on the Mall and will be the scene of many festivities during the fair. It will be beautifully decorated with multicolored lights, pioneer figures and 100 great candles. In its interior will be a concealed music box.

The second cake, a tasty piece of pastry weighing 500 pounds, will be cut and distributed to fairgoers at a special birthday party at the Open Air Theater on September 9th, the anniversary of Admission Day.

Everything is being made shipshape, including the roads leading to the fair, for the hundreds of thousands of visitors, many of whom will motor to the state capital.

Nine state highways converge in Sacramento. These routes, radiating to the points of the compass, bring a constant flow of traffic to California's Capital from the several sections of the State.

Heterogeneous is the traffic traveling these routes; mammoth trucks, trailers and semitrailers, built to meet the varied demands of industry and commerce; grey busses, swift, slim and towering; medium-sized trucks and bob-tailed pickups of every description and carting every commodity; passenger cars of every make, model and vintage carrying salesmen, plumbers, mechanics, farmers, legislators, bankers and doctors, dowagers, sweet young things, and mothers with a car full of children. All these and many more make up the traffic flowing in all directions to and from Sacramento, the Capital City of California.

Nine State Routes to Capital

The nine state routes over which this traffic floods and ebbs include U. S. 40 to the west connecting Sacramento with the San Francisco Bay area and the west side of the Sacramento Valley, by way of U. S. 99W; U. S. 40 toward the east, the transcontinental highway which crosses the Sierra at historic Donner Summit; traffic from the east side of the Sacramento Valley uses this same entrance on U. S. 99E, joining with U. S. 40 at Roseville.

From the east also comes the flow of traffic on U. S. 50—the other transcontinental highway which enters California along the south shore of Lake Tahoe, climbs over the Sierra at Echo Summit and down to the valley via the American River Canyon and Placerville. To the south the principal state highway into Sacramento is U. S. 99, the central artery of the State Highway System, connecting the Capital City with the broad San Joaquin Valley, the vast metropolitan area of Los Angeles and the entire southern portion of California.

Roads Serve Large Area

Of less significance from the standpoint of traffic volume, but most important to the areas they serve, are the other five state highways which enter Sacramento.

From the delta lands on the east side of the Sacramento River, State Sign Route 24, on the levee, follows the river and carriers streams of vegetable produce from the rich delta soil to the packing plants, asparagus, spinach and tomatoes—each in its season. Similarly, State Highway 99 serves as the connecting link from Rio Vista and the delta lands on the west side of the river.

From the northwest quadrant State Sign Route 16-24 enters Sacramento over the I Street Bridge, having crossed from the westerly side of the Sacramento Valley to Woodland and along the west bank of the river.

The foothill country of the Mother Lode to the southeast is connected with Sacramento by the "Jackson Road," State Sign Route 16, which joins U. S. 50 at Perkins, just outside the city limits.

New American River Crossing

State Highway 98 is a route which originally was taken into the State Highway System primarily as a "by-pass" of the city, connecting U. S. 40-99E at Fulton Avenue northeasterly of the city, entering on the "H" Street Bridge across the American River and again joining U. S. 99 at 14th Avenue in the southeasterly section of the city. However, this routing has been superseded by the route adopted crossing the American River near Elvas Junction, as mentioned in one of the following paragraphs, and statutory provisions prohibit the State from making any further capital expenditures on the original routing. Maintenance, of course, remains a function of the State until the newly adopted routing is constructed.

All of these state routes are paved highways, adequate for the traffic loads they are called upon to carry, ready to speed visitors to the State Fair or to the capital on business.

U. S. 40 from San Francisco to Sacramento is a four-lane expressway over all but 10 miles of its entire length and construction to four-lane divided

. . . *Continued on page 55*


CALIFORNIA
STATE
FAIR
at
SACRAMENTO
Via THE WORLD'S
FINEST HIGHWAYS
MONTEREY
SAN JOSE
STOCKTON
MARYSVILLE
GRASS VALLEY
SAN LUIS OBISPO
MODESTO
SANTA BARBARA
FRESNO
SONORA
VENTURA
BAKERSFIELD
PORTERVILLE
BRIDGEPORT
LOS ANGELES
SAN BERNARDINO
SAN DIEGO
PALM SPRINGS
BARSTOW
EL CENTRO
NEEDLES
RED BLUFF
CHICO
FT. BRAGG
EUREKA
VALLEJO

An Experiment

Prefabricated Steel Decking Used for Smoky Gulch Bridge

By W. B. PIPER, Assistant Bridge Engineer

RECENTLY a new type of bridge deck was used in the reconstruction of a bridge across Smoky Gulch in the desert area of Riverside County. The bridge is located about 7.4 miles east of Indio, on U. S. 60 and 70, which is one of the main highways going east from Los Angeles.

The existing bridge consisted of twelve 19-foot timber spans on timber pile bents with a laminated timber deck surfaced with asphalt. The deck structure had become badly deteriorated and the riding surface had become extremely rough, resulting in a high maintenance cost. In the face of its poor structural condition and inadequate roadway width, a new superstructure was an economic necessity. Inasmuch as the existing substructure of the bridge was in good condition, it was decided that it would be structurally feasible and economically desirable to utilize the existing substructure and replace only the deck system.

An Experiment

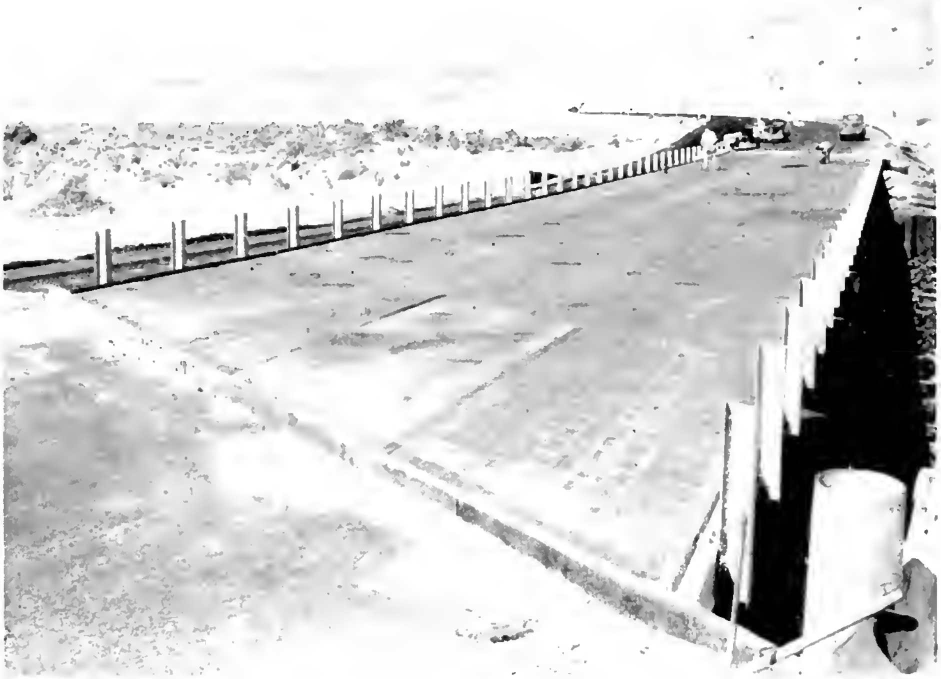
As an experiment, the Bridge Department decided to replace the conventional timber stringer and deck system with prefabricated steel panels. The original theory, as developed by the Bridge Department, was that:

(1) By using prefabricated panels the bridge would be out of service during redecking for a much shorter time than would result from other methods.

(2) That the initial cost would be favorably comparable to that of a concrete deck placed on timber stringers; and, furthermore, would present the possibility of full recovery of the deck structure and re-use in the event of relocation of the bridge.

(3) That redecking by this method could be utilized in a half-at-a-time operation, thus enabling a detour to be dispensed with; and

(4) That if it were necessary to build a detour the rapid progress of the replacement operation would enable the use of the detour to be cut to a minimum, thus making a saving in the quality of the detour required.



Nearly completed bridge ready for guard rail installation

Applicable to Other Bridges

This experiment was initiated in the hope that a feasible system of reconstruction could be developed which would be applicable to the many timber desert bridges which are near the end of their service lives and which will have to be reconstructed within the next few years.

The prefabricated deck was made entirely of structural steel and each unit was complete in itself and entirely independent of the other units. Thus the individual sections were fabricated so as to fit any place into the structure without the necessity of matchmarking.

The panels consisted of a steel plate deck, I-beam stringers, and channels along the edges of the section, all welded into standard 7-foot x 19-foot panels. The floor plate was seven-sixteenths inch steel supported on two 10-inch intermediate I-beams with 10-inch channels along the edges of the panel.

Four by one-quarter inch plate stiffeners were used at 15-inch centers. The units were entirely assembled in the shop and were welded throughout. The design of the panels will sustain an H-20 loading.

Heavy Truck Traffic

The Smoky Gulch Bridge lies near the foot of a long 6.3 percent grade, and carries a very heavy volume of traffic, a major portion of which is comprised of heavy trucks. These heavy trucks travel at extremely high speeds down the long grade and it was felt that in this particular location an attempt to reduce this fast moving traffic over a one-way bridge would be specially hazardous. Therefore, it was decided that the danger was too severe at this location to attempt to redeck the bridge one-half at a time and a detour was provided.

An economic study showed that at this location a detour could be built at a cost very little over that required to provide flagmen to control the traffic.

As soon as the detour was placed in operation the existing timber deck was removed from the pile bents and an additional cap was installed. Immediately thereafter the steel panels were placed upon the bents. The 48 units were placed in 2½ working days and two additional days were utilized in bolting the units together and installing the rail posts and metal guard rail.

Floor Panels Bolted

The floor panels were bolted together with six ¾-inch bolts at each side and two at each end. The panels were fastened to the pile bent caps with four ¾-inch bolts. Expansion was provided for by placing a ¾-inch expansion filler at each end of each span.

The panels were very easy to install. They weighed less than three tons and were set in final position by a truck crane picking each panel individually directly from the delivery truck. Full loading can be applied to the structure immediately after the panels are erected. It was originally planned that this feature would lend itself to opening the bridge to full width each night in the event that half-at-a-time operation was attempted. However, if the bridge were to be opened for traffic each night, it would be necessary to cut the adjacent timber stringers off at the center line of the cap adjacent to the last steel panel which was placed, in order to provide a continuous surface for the traffic to use.

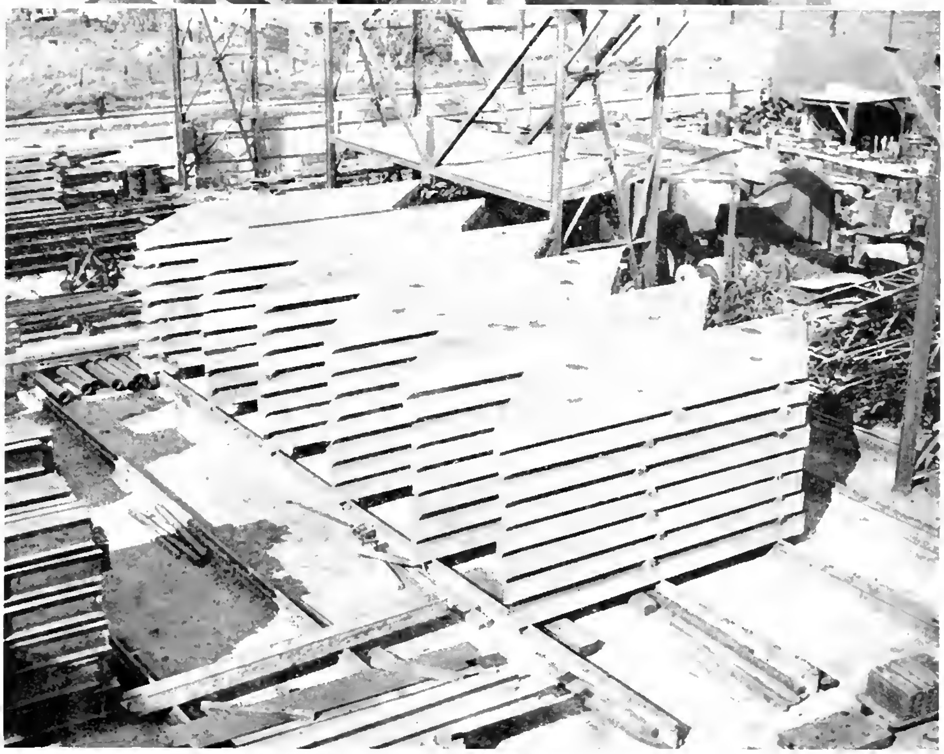
An all-steel hand rail was provided for the structure. The posts were fabricated from 6-inch I-beams on which a spring steel metal guard rail was mounted. There was no curb or sidewalk provided on the bridge. The clear roadway width was 26 feet 10 inches. A 3-inch asphaltic surfacing was placed over the metal panels.

Successful Experiment

As an experiment, the Smoky Gulch Bridge is regarded as a successful innovation. After study of the fabrication problems and the appearance of the final design, it is believed that the makeup of the panels can be considerably simplified if they are to be used in a future design.

Another problem which may prove troublesome is the successful maintenance of the asphaltic surfacing on the smooth surface of the steel deck plates. It is believed, however, that the design utilized on this structure offers great possibilities as a mass production system of replacing desert bridges.

. . . Continued on page 49



UPPER—Stiffeners used to considerable extent in original design may be considerably reduced in later applications. Cost of slightly heavier plate will be more than offset by savings in fabrication costs. LOWER—The 45 degree skew of the pile bents on the Smoky Gulch Bridge required fabrication of special sections. This special section retains all of the advantages of easy stock piling, handling, and shipping

FREEWAY AGREEMENT SIGNED WITH CITY OF POMONA

By FRANK C. BALFOUR, Chief Right of Way Agent

On Tuesday, May 16, 1950, the Pomona City Council passed the necessary resolution authorizing Mayor Alan G. Osborn to execute the freeway agreement with the Division of Highways covering the treatment of city streets in connection with the routing of the Ramona Freeway through that city.

Some two years ago the City Council of Pomona passed a similar resolution and the then mayor of Pomona executed a freeway agreement, which action was later rescinded because of a major controversy regarding the routing of the freeway through the city.

The controversy has finally been adjusted after many conferences and meetings, with the result that the routing of the Ramona Freeway through Pomona is the ideal one for the best interests of the traveling public and also will represent the best possible routing to serve the present and future requirements of the City of Pomona.

On Friday morning, May 19, 1950, the members of the California Highway Commission while on a tour of inspection of state highways in the easterly section of Los Angeles County, the westerly section of San Bernardino County, and Orange County, made a brief stop at the Pomona City Hall where the Highway Commission and the city council held a short joint meeting, at which time Director of Public Works C. H. Purcell presented a copy of the freeway agreement executed on behalf of the State of California, to Mayor Osborn.

This act terminated and brought to a conclusion satisfactory to the people of Pomona and to other interested sections of Southern California, a controversy of long standing, with the result that there will be no further delay in the planning and construction of the Ramona Freeway through the easterly section of Los Angeles County and extending on through Ontario, Upland, and the westerly portion of San Bernardino County as well as to and through the City of Colton in that county.

AS WE SEE IT

BY ONE OF US

The visit of the Highway Commission and other officials of the State of California to Pomona this morning marked not only a gesture of good will to the Pomona City Council, Pomona Chamber of Commerce and the community as a whole but the beginning of a new era of development and progress, according to the opinion of many who witnessed the informal but very significant ceremony.

Each passing month will make more graphic the debt of gratitude which Pomona owes to the California State Highway Department. Already only three days after the signing of the freeway agreement the three-year economic coma which has held dormant the growth of Pomona is beginning to break. Plans for construction of new subdivisions and apartment houses are in preparation. Investment agencies are checking the territory. Three industries have reopened consideration of Pomona as a possible plant location city.

This reaffirmation of general faith in the future of Pomona is the direct result of the infinite patience of members of the Highway Department during a three-year period of negotiations which at times might well have discouraged their interest in holding the Ramona Freeway high on the critical urgency list.

Time after time representatives of the department came to conferences in Pomona in sincere attempts to work out the problems of Ramona Freeway in a spirit of cooperation. Even when the lack of understanding between city and State was at its worst, there was no stressing of the power of the State to transverse the city without regard to the city wishes. At any time during those past three years the State could have proceeded with either a limited access highway, which would have poured traffic through our city and left our citizens the hazard of crossing without over or underpass protection, or a freeway with no ingress or egress ramps for the use of traffic bound to and from Pomona. But through all discussions, the department held fast to the plans which their studies had shown to be for the best interests of the citizens of Pomona as well as the State.

It is to their patience and unfailing courtesy that Pomona owes the fact that construction will soon start on what will be one of the most modern parkways in the world. The sincere efforts of city councilmen, during 60 days of intensive study of freeway problems, and the understanding assistance of Highway Department personnel have opened the door to a bright future for our city. Pomona is grateful to her local public officials and deeply indebted to the entire personnel of both the State Highway Commission and the Highway Department.

Reprinted From the Editorial Page of The Pomona Progress-Bulletin, Published May 19, 1950

State delivers Pomona Freeway agreement. LEFT TO RIGHT: Frank C. Balfour, Chief Right of Way Agent; Mayor Allen G. Osborn; Director of Public Works C. H. Purcell; George Kirkpatrick, President Pomona Chamber of Commerce

El Camino Real

Calabasas Job Part of Steady Improvement of Freeway U. S. 101

By C. P. MONTGOMERY, District Construction Engineer

Among the highways of California, El Camino Real is outstanding in historical significance. It is the route by which Christianity and the culture of Western Europe were brought by Junipero Serra and his padres to the country which now forms the Pacific Coast of the United States.

With the influx of Americans, drawn to Central California by the lure of gold and to Southern California and the San Joaquin Valley by the agricultural possibilities, the tranquil existence in old California underwent a gradual change. The ranchos of the Spanish Dons were divided into ranches of the gringos. In line with these changing conditions El Camino Real evolved into a stage road, over which transportation was provided between the Pueblo of Los Angeles and San Francisco.

These stages, built for sturdiness rather than comfort, pulled by four or six horses according to the terrain, were operated on a regular schedule. Stage stations were so located as to serve meals for the passengers where stops were made to change horses, and larger stations at overnight stops provided lodging as well as meals and "liquor, cigars and tobacco."

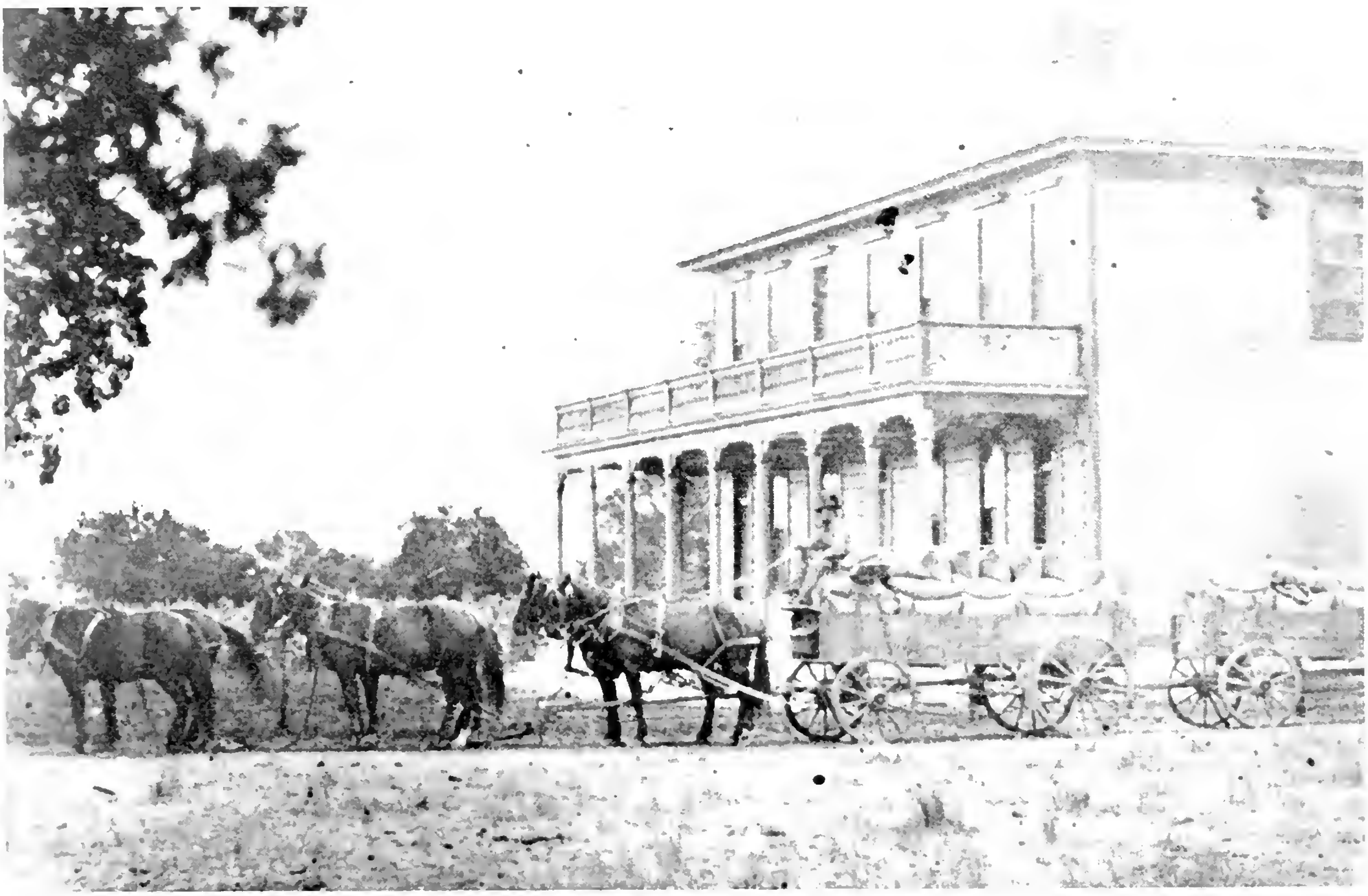
Old Stage Route

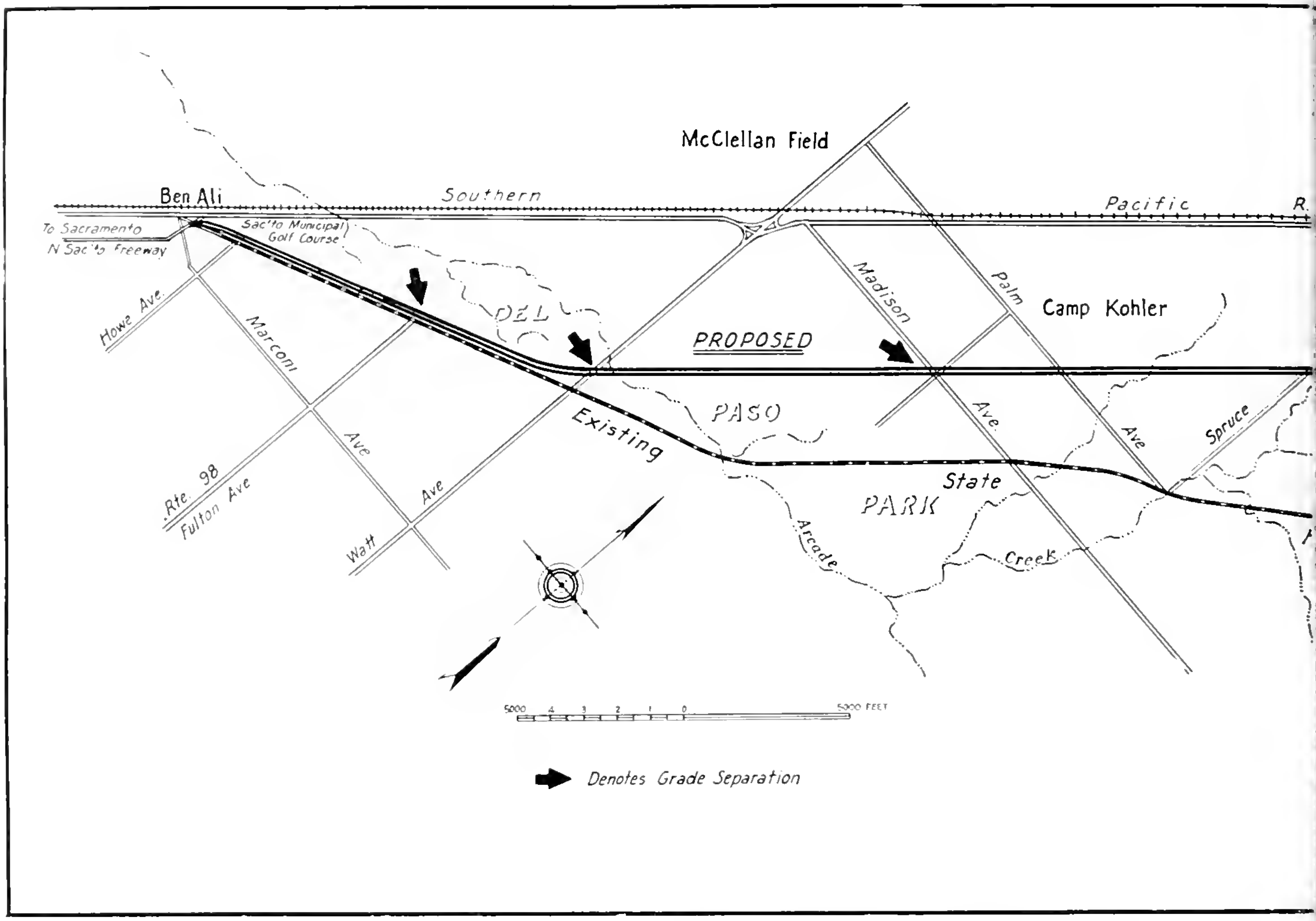
The traveler northward bound from Los Angeles in the seventies and early eighties would leave Los Angeles in the morning, stop at the Encino station for lunch while the horses were changed, probably stop again in mid-afternoon at Vejar station (now Agoura) and spend the night at Newbury Park.

Resuming his journey the following day, a change of horses was made at Camarillo with another overnight stop at Ventura. The old Vejar station, a splendid specimen of adobe construction, was in good state of preservation in 1913, but has since been torn down. The Newbury Park station still stands by the side of the present highway, minus the porch across the front and

. . . Continued on page 58

Newbury Park Stage Station in 1887





The above map shows the proposed highway relocation involved in the case "Existing State Highway Route 3." Plaintiffs were owners of businesses located map as "Pro

Freeway Law

Continued from page 1 . . .

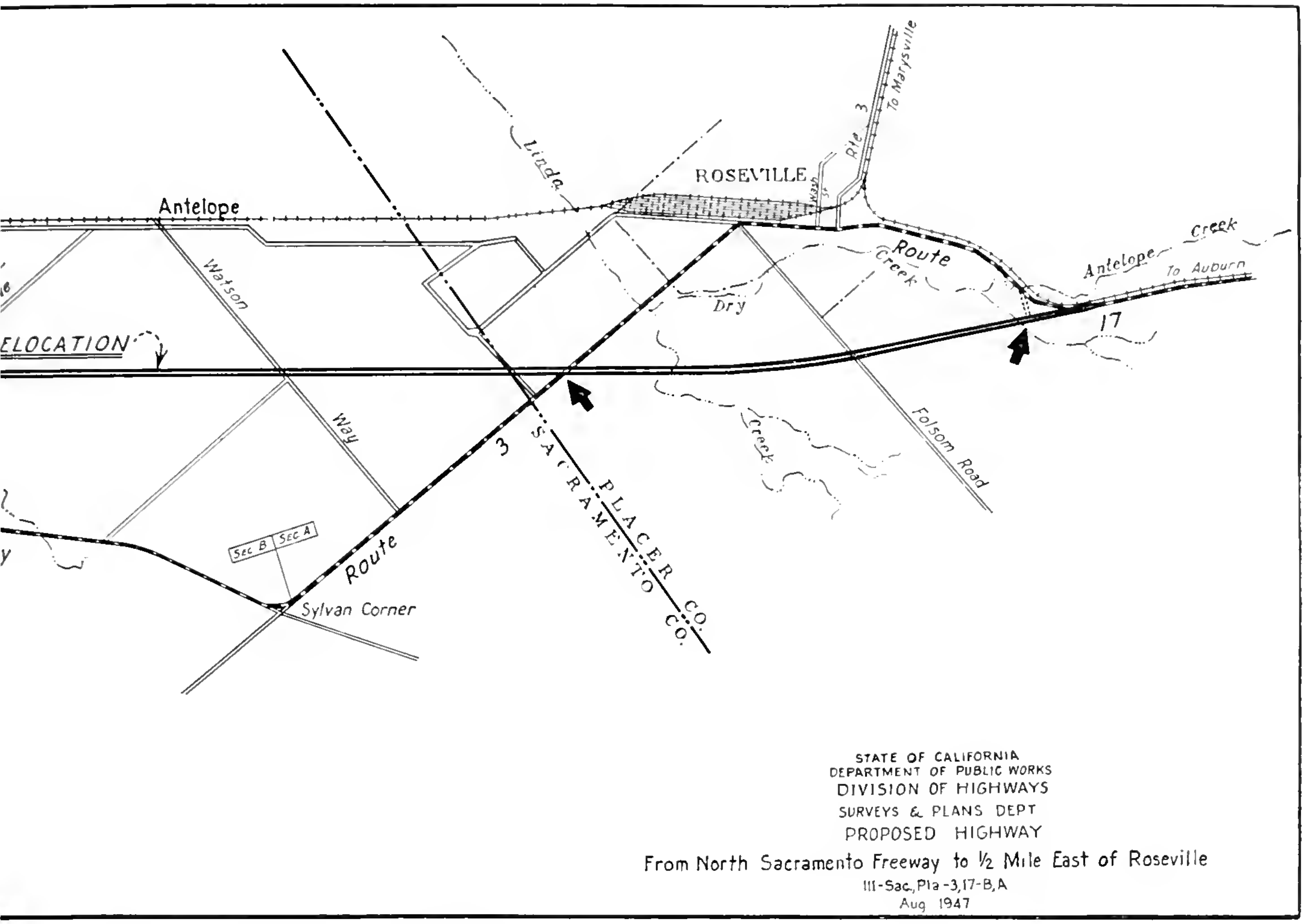
of 'permanent' in the statute is durable, not perpetual. No one can predict how long a highway will serve the purposes for which it was constructed. The first sentence in Section 8 upon which plaintiffs rely requires that highways be constructed of durable materials to insure a free flow of traffic over highways that are adequate to carry it, not to compel the perpetuation of routes that have outlived their original usefulness."

On the question of the construction of the phrase, "permanently maintained and controlled by the State of California," the court continued:

"The requirement of permanent maintenance is not one of permanent location. The purpose of this requirement is obviously to insure state maintenance of the highways so that the burden of maintenance will not fall upon the counties. This provision must be read in connection with the preceding sentence, to the effect that the counties are responsible for the interest on the bonds issued by the State. After the relocation of the part of Route 3 now proposed has been concluded the State will still be controlling and maintaining the highway specified as part of the system described in Section 4 of the 1909 act, namely, 'a continuous and connected State Highway System running north and south traversing the Sacramento and San Joaquin valleys * * * by the most direct and practical route.' The requirement of permanent maintenance does not preclude the State from relocating a highway and thereafter maintaining it as relocated. * * * "

In further support of its interpretation, the court pointed out that the State Department of Engineering, which was empowered to establish and administer the highway system provided for by the Highway Act of 1909, actually had been created two years before (Stats. 1907, Chap. 183) and had been, in the act creating it, expressly authorized to relocate, as well as to construct, "roads which have (had) been declared state highways." As the court pointed out, "there can be no question that the express authority to relocate state highways when necessary in the public interest is one of the 'things necessary and proper' to the maintenance of the highway system authorized by the 1909 act. * * * "

In other words, the so-called bond act roads are in no different category with respect to their relocation than other highways in the state system. This had been the position of the department's attorneys as well as the



...way v. Purcell. The present location of Route 3 (U. S. 40, 99E) is indicated as ...xisting highway. They opposed construction of a freeway indicated on the ...location."

conclusions of the Attorney General, whose specific opinions approving major relocations were cited to the court.

Thus, 40 years after it was approved by a vote of the people in 1910, the basic highway legislation of California has been interpreted, as the court says, "in accord with the administrative, legislative, and judicial interpretation that it has always been given."

Such major relocations as that on the Ridge Route between Grapevine Station and Castaic, in Shasta County around Shasta Dam and Reservoir, the by-passing of Davis, Dixon, Vacaville and Fairfield, as well as many others completed and contemplated, all of which without question can be shown to be "necessary in the public interest," if there ever was any legal question as to their propriety, are now by the decision in *Holloway* v. *Purcell* fully and finally validated.

The second major proposition put forth by the plaintiffs in the *Holloway* case was that construction of freeways in California is invalid.

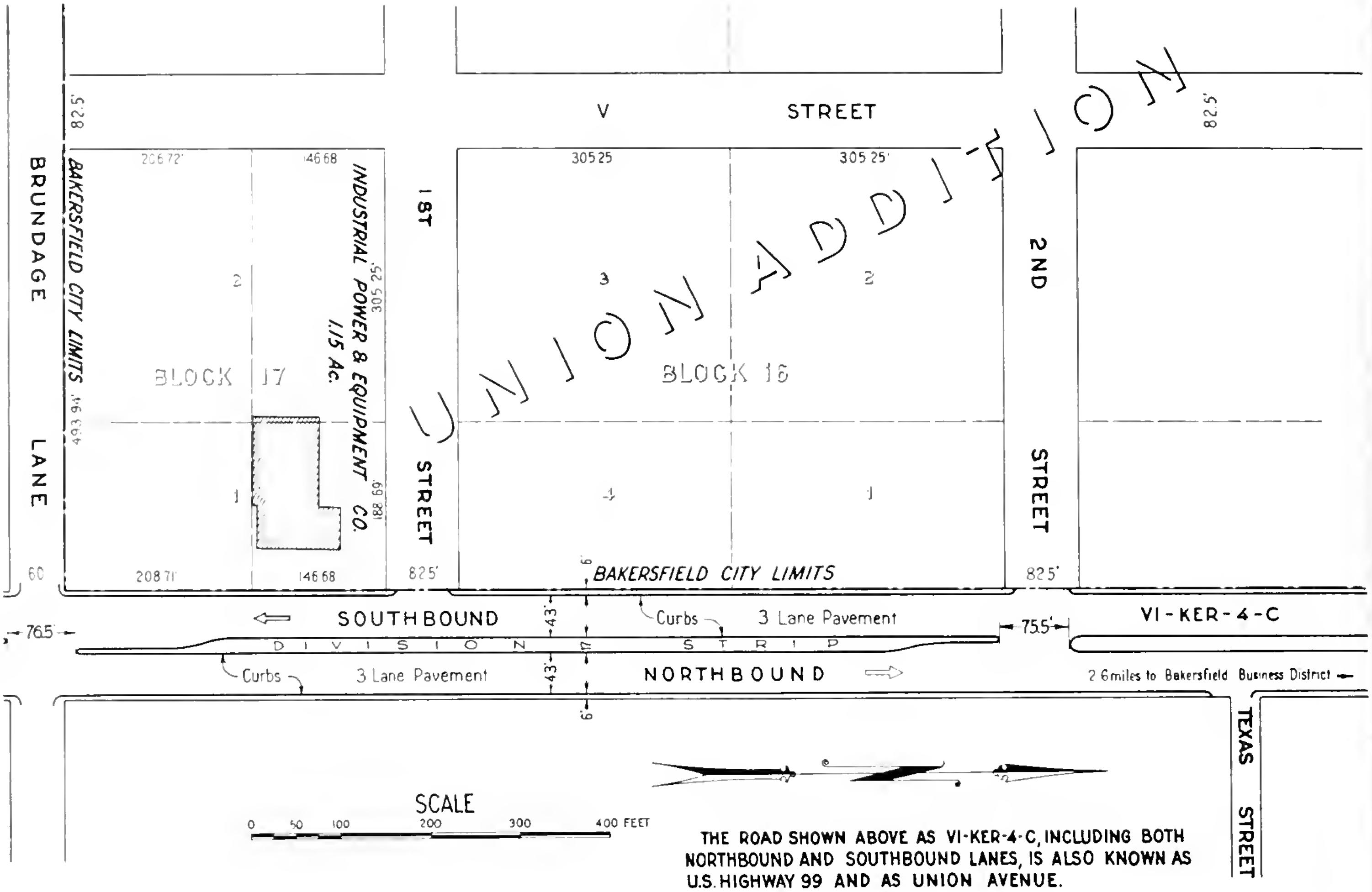
It was their contention that Article IV, Section 36, of the State Constitution, adopted by the people nearly a half century ago, and providing that "the Legislature shall have power to establish a system of state highways * * * and to pass all laws necessary and proper to construct and maintain the same" precluded the Legislature from authorizing "relocation of any highway once established under that section" as well as "construction of any type of highway not in general use in 1902"!

To this the court replied that the constitutional provision was designed "solely to authorize the establishment of a State Highway System." It refused to read into it an "unwritten provision" that would preclude relocation of "highways once established" as might be "required by changed conditions."

Freeways Held Necessary to Modern Highway System

And, in approving the 1939 statute providing for a type of highway now required by "changed conditions," Justice Traynor had this to say regarding the California freeway legislation:

> "The construction of freeways or limited access highways is within the statutory authority of the State Highway Commission and the Department of Public Works." (Citing Streets and Highways Code Sections 100.1, 100.2, 100.3.) "In their (plaintiffs') view, the Constitution prohibits the construction of any type of highway not in general use in 1902, when Article IV, Section 36 was added to the Constitution. It is contended that inasmuch as freeways



The situation in Holmon v. State of California is shown on the above map. Plaintiffs were owners of property at the northeast corner of First Street and the state highway (VI-Ker-4-C). They claimed extension of the center division strip across the intersection of First Street damaged their property

and limited access highways cut off access from cross streets and highways, statutes purporting to authorize their construction are unconstitutional. That contention is without merit; it attributes to the California Constitution a rigidity that would freeze the highway system into routes that in time might bear no relation to traffic.

"The Constitution authorizes the Legislature to establish a system of state highways adequate to meet the needs of the State, 'and to pass all laws necessary or proper to construct and maintain the same.' The type of highway that is adequate to meet traffic needs necessarily varies with the character and extent of those needs. Highways adequate for the horse and buggy traffic of 1902 are not adequate for the high-speed motor traffic of 1950. Highways that satisfactorily connected rural communities have been replaced by super-highways, parkways, and freeways designed to meet the needs of heavy interurban automobile, truck, and bus traffic. * * * Their construction is not constitutionally prohibited by a provision authorizing the establishment of a State Highway System merely because there was no need for them when the provision was adopted.

"We conclude that the construction of freeways and limited access highways is 'necessary or proper to construct and maintain' a modern State Highway System."

The court then went on to say that "The construction of a freeway does not, as plaintiffs contend, necessarily constitute a taking of private property rights of access without due process of law." However, the court was careful to point out that "rights of access restricted by the construction of freeways are taken or damaged by the State under its power of eminent domain and their taking is compensable under Article I, Section 14." It should be pointed out here that the department has never contended otherwise and did not so contend in the instant case. Justice Traynor pointed out further that the Supreme Court has "repeatedly held that it is permissible to take or damage rights of access for which compensation is paid in the construction of a freeway."

On the question of plaintiffs' asserted injury to their businesses by relocation of the highway which, in essence, was real basis of their complaint, the court held that while this might be true, it did not deprive them of any "rights of access as abutting owners," and that "construction of the highway past their places of business gives them no vested right to insist that it remain there." What plaintiffs were really contending

for, the court said, quoting from the State's brief, was "a changeless road in a changing world." This, it held, they were not entitled to.

Thus the well established rule that diversion of traffic is not a compensable element of damage in a highway eminent domain case is again upheld in California.

In their brief, and particularly at the oral argument, plaintiffs vigorously contended that the Legislature was without power to delegate to "a minor administrative body," such as the California Highway Commission, authority to designate and to construct freeways and that the freeway sections of the code "improperly" delegated such authority.

This was an important point, since it constituted an attack upon the validity of numerous acts of the commission taken since enactment of the freeway law in 1939, as well as the expenditure of many millions of dollars on freeway projects. But here again the court was not impressed by plaintiffs' arguments. It said "The Legislature * * * may establish a broad statutory rule and delegate to an administrative agency the duty of specifically applying that statute within the framework of a sufficiently definite primary standard. 'The practice of delegating to administrative officers or boards powers which were originally performed directly by the Legislature is of long standing and has met the approval of the highest courts in this State as well as in other jurisdictions.' * * * An administrative agency may properly be given the authority to construct and maintain or to abandon and relocate highways, to build freeways or limited access highways, and to do anything else necessary to the maintenance of a State Highway System.

"The statutes in question require the commission to exercise its authority only on 'such terms and conditions as in its opinion will best subserve the public interest.' That requirement provides an adequate standard to guide the commission. * * * "

" 'The Legislature,' the court said in its concluding paragraph, 'has adopted a policy of freeway construction in the public interest. It has properly delegated to the highway commission the authority to determine when and where freeways will be constructed, and it has properly required that the authority be exercised in accord with the needs of the public interest. Such a delegation of legislative power is valid.' "

In other words, the freeway law is *constitutional.*

It may now be said on the authority of *Holloway* v. *Purcell* that whenever the Department of Public Works and the California Highway Commission determine to relocate or reconstruct state highways, to relinquish or abandon superseded portions thereof, or to establish and construct highways as freeways, or otherwise to exercise the powers which the Legislature has delegated to the department and the commission with respect to the state highways, their authority so to do will not be subject to question, if they act, as they have in the past, in good faith to "best subserve the public interest."

The State's brief in the *Holloway* case was largely the work of Mr. C. R. Montgomery, late Chief Counsel for the Department of Public Works. His well known ability to present a clear, incisive, and powerful legal argument was never better demonstrated than in this instance. His appearance at the hearing before the Supreme Court shortly before his untimely death may be considered his last important assignment for the department. He did not live to know the outcome of this important litigation, but those of us who were associated with him for so many years in the legal work of the department will always remember Clifton Montgomery when we have occasion to review the record in *Holloway* v. *Purcell.*

The second of the recent highway cases, *Holman* v. *State of California, 97 A.C.A. 282*, was an inverse condemnation action against the State for damages to abutting property solely by reason of the construction of a center dividing strip on Route 4 (U. S. 99) in the City of Bakersfield. No question of the relocation of the highway or of a freeway was involved.

In the Superior Court for Kern County, Judge Robert B. Lambert sustained the State's general demurrer without leave to amend and an appeal from the judgment was taken to the Fourth District Court of Appeal. The appellate court on April 27, 1950, unanimously affirmed the judgment for the State. A petition for a hearing in the Supreme Court has been denied by the latter court.

The situation in the Bakersfield case is shown on the accompanying map. Plaintiffs, doing business as the Industrial Power and Equipment Co., own the property at the northeast corner of First Street and the State highway, designated on the map as "VI-Ker-4-C." They are engaged in the business of servicing heavy trucks and equipment. The highway involved is, as has been indicated, of the conventional type which, for traffic safety, has been divided, as shown, into opposing lanes by a center division strip consisting of a concrete island some 8 inches high and 6 feet wide extending down the center of the highway and across its intersection with First Street. This dividing strip is the improvement complained of and the alleged damage was based on the fact that vehicles moving in a northerly direction on the State highway may not now make a left-hand turn through the center strip and across the southbound lanes directly into plaintiffs' property, and, likewise, vehicles leaving plaintiffs' property may not proceed directly across the southbound lanes and immediately make a left-hand turn to proceed in a northerly direction.

Whether or not this factual situation resulted in a compensable damage to plaintiffs' property was the sole issue in the case.

The contentions of the respective parties are thus summarized by the court:

> **"It is the contention of the plaintiffs (property owners) and of the amici curiae that the plaintiffs, as abutting owners, have the right to the use of the highway in either direction and that they are entitled to compensation for any damage occasioned by the construction of a public work or improvement in the highway interfering with their access to the next intersecting street in either direction from their property.**
>
> **"The defendants (State) contend that the case involves solely 'circuity of travel' or 'diversion of traffic' which is not compensable because no violation of property rights is involved; that depreciation in value, if any, resulted**

. . . Continued on page 46

Erosion Control

Methods Used on California State Highways Discussed

By H. DANA BOWERS, Supervising Landscape Architect

California, a wrinkled ribbon of land more than 800 miles long lying between the high Sierras and the Pacific Ocean, stretches from the humid forested zone characteristic of the Pacific Northwest to arid northern Mexico, and ranges in elevation from below sea level to more than 14,000 feet. Climatic variations are extreme, as might be expected, and erosion control problems vary correspondingly. Many different types of control have, therefore, been found to be necessary.

The purpose of this series of articles is to discuss the variable factors associated with erosion which affect California roadsides, review the development of erosion control methods by the State Division of Highways, and describe erosion control processes now being employed with reasonable success to stabilize slopes on California state highways. This is the fifth installment.

It is felt that at least a few of the methods which have proved effective in California may be modified to suit conditions in other regions. Consequently, descriptions have been made as complete and are illustrated as fully as possible in order to permit duplication of these methods by nontechnical personnel.

The erosion problem on agricultural lands is another matter entirely. Since this phase of the subject is adequately treated in publications of the Soil Conservation Service we will consider here only erosion as it directly affects roadsides.

BRUSH WATTLE METHOD

This is an early method used for stabilizing fill slopes after construction. Fair control was obtained with this method, but it has several distinct disadvantages.

All operations must be done by hand labor. This means that unless a cheap source of labor is available, such as a prison road gang, a CCC crew, or WPA or its equivalent, the labor cost is so high as to make the cost of installation prohibitive.

Wattles installed in trenches intercept and hold runoff water. No further runoff can take place until the trench is filled with water to the overflow point. This condition cannot help but result in saturation of the uncompacted soil around and below the wattle, with consequent undermining or slumping and failure during storms of high intensity.

ROCK METHOD FOR FILL SLOPE STABILIZATION

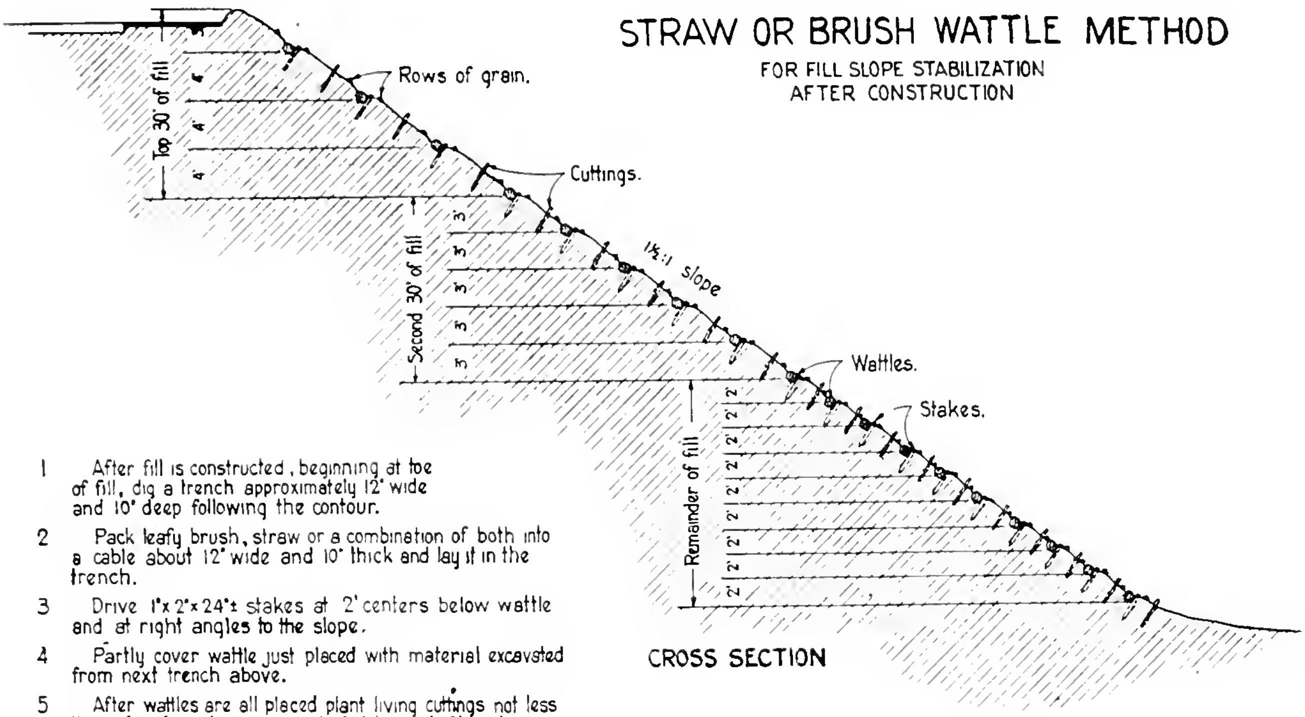
An effective method used where practicable for mechanically stabilizing fill slopes involves the use of rock. In locations where excavated material containing sound rock is available within a reasonable hauling distance, chunks of rock, the larger the better, are placed in the outer portion of the embankment as the fill is made. Portions of the embedded rocks protrude from the fill surface. Since the rocks themselves are not subject to erosion, the possibility of damage is confined to the intervening spaces where the finer surface material is exposed. This vulnerable area may be reduced or even eliminated if enough rock is available to overlay the slope surface completely. In addition to offering protection from surface erosion, the embedded stones decrease the tendency toward saturation and slumping which is so characteristic of slopes composed entirely of finer materials.

Hard, gullied disintegrated granite fill slope. Construction of log and brush crib at toe of slope is first step in repair procedure. (Near Weaverville, Trinity County)

The degree of vegetative protection required on a rock-treated slope depends upon the extent of rock coverage. If very little granular material is visible, seeding plus tree and shrub planting (provided sufficient "fines" are present to support plant growth) will be sufficient. If a significant amount of exposed material will be subject to erosion, the straw and seed method followed by tree and shrub planting may be required. In any event, some planting should be done, not only to improve appearance, but to arrest the gradual downward movement of stones and gravel which

STRAW OR BRUSH WATTLE METHOD

FOR FILL SLOPE STABILIZATION AFTER CONSTRUCTION



CROSS SECTION

1 After fill is constructed, beginning at toe of fill, dig a trench approximately 12" wide and 10" deep following the contour.

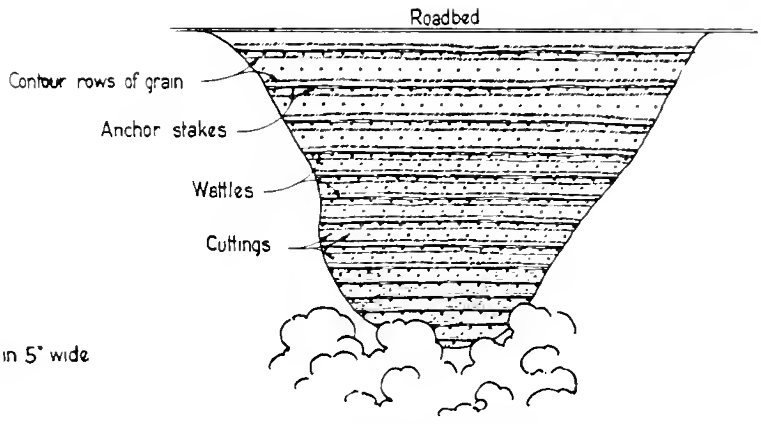
2 Pack leafy brush, straw or a combination of both into a cable about 12" wide and 10" thick and lay it in the trench.

3 Drive 1"x 2"x 24"± stakes at 2' centers below wattle and at right angles to the slope.

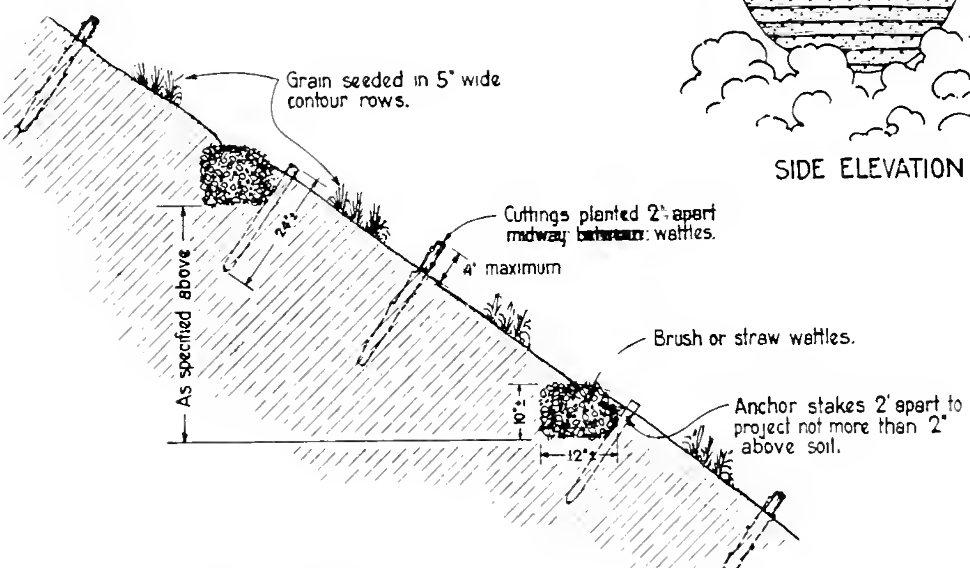
4 Partly cover wattle just placed with material excavated from next trench above.

5 After wattles are all placed plant living cuttings not less than 1" in diameter and 24" to 30" long at 2' centers in rows midway between wattles. Set cuttings in the ground until they protrude only 3" or 4".

6 Seed Barley, Rye grain or Alfalfa in 5" wide rows just above and just below each wattle and broadcast additional seed evenly over surface of slope.



SIDE ELEVATION



DETAIL SECTION

seems to be constantly taking place on unvegetated rocky slopes.

USE OF STRAW MULCHES IN SLOPE STABILIZATION

The function of a straw mulch, as previously discussed, is to afford protection to the soil until vegetation has become established. Lasting qualities of the straw are considered relatively unimportant, since after the first growing season plant growth should be sufficiently dense to retard soil movement, and the straw protection should no longer be required. Considerable latitude is, therefore, allowed in our specifications as to the type of straw to be used. Wheat, barley, oat or rice straw are usually specified as choices, although spoiled hay (alfalfa, grain, or wild-grass) would be acceptable provided it was not rotted or extremely brittle. Used stable bedding from the race tracks, consisting of barley straw mixed with horse manure, was obtained at a reasonable price by several contractors and used successfully on the high fill slopes of the City Creek Road in the San Bernardino Mountains. The type of straw used in a given locality is, therefore, governed by availability and price rather than by variety.

Straw Rollings

Rates of application are related directly to the number of rollings with the sheepsfoot roller which are specified, and the type of soil encountered. Each pass with the sheepsfoot roller presses some of the straw so deeply into the soil that it is no longer visible or effective as surface protection. Highly erosive soils, then, which require the thorough compaction which many trips of the roller will produce, the consolidating influence of the embedded straw and also the surface protection provided by protruding straw, require a higher rate of application than less critical soils.

Ordinarily, an application of four tons of straw per acre is specified. This rate is based upon the quantity of average quality straw of the variety which is most often furnished (in our case, barley) which is required, when evenly spread over a slope acre, to cover the average soil to such depth that after one rolling with a sheepsfoot roller enough straw will remain exposed on the surface to afford protection. The accompanying illustrations show the normal application of four tons per acre both before and after rolling. A rate of six to eight tons of straw per acre is usually specified in locations where the degree of compaction desired calls for from six to as many as twelve passes with the roller, in order to insure that enough straw will remain on the surface after the rolling operation has been completed. Since the sheepsfoot roller will not compact the soil effectively if the straw blanket is spread at an appreciably heavier rate than four tons per acre, the six- to eight-ton covering is spread in two applications, each followed by a thorough rolling.

Unit of Measurement

Short, brittle or very coarse straw does not cover the slope surface so well as new long-stemmed straw; and if only straw of this poorer quality is available, the rate of application should be increased until a sufficiently thick covering is left on the surface after rolling to offer the protection desired.

The unit of measurement, "tons per acre," has been found to be the most practical unit to use. Bales of straw vary both in size and weight, and the unit "inches depth" is too dependent upon whether the straw is stiff or limp or has been baled tightly or loosely.

In all cases where slope surface protection areas are involved, the terms "acre" or "square yard" refer to slope measurement.

USE OF SHEEPSFOOT ROLLER IN SLOPE STABILIZATION

Several methods have been developed for utilizing a sheepsfoot roller in compacting the slope face and incorporating the straw with the soil.

When rolling 1½:1 and 2:1 cut slopes, a single roller equipped with a yoke has been connected by wire cable to the power-operated drum unit located on the back of a Caterpillar tractor. The roller is lightened of ballast to the point where it will roll down the slope when the cable is slack but is not so heavy as to cause an excessive load on the power unit when being pulled back to the top of the slope.

The tractor is positioned at the top of the slope, broad side to the slope face. The roller is let down, speed of descent being controlled by the power unit brake, then pulled to the top of the slope. After the required number of round trips are made, the tractor is moved a distance equal to the width of the roller and the process repeated.

Rolling Cut Slopes

While this method has been most often used for rolling cut slopes, it is also adaptable for rolling embankment slopes, although more roller ballast may be required in order to load the roller to the point where it will roll down the slope of its own weight in the looser soil.

When 1½:1 embankment slopes composed of very loose or granular soil, such as disintegrated granite, are to be rolled, it may be necessary to give the slope one preliminary rolling before straw is spread in order to compact the soil lightly. If straw is spread on very loose soil, the roller tends to push the straw and loose soil ahead of it on the first downward trip.

When straw is spread on the completed portion of a fill slope at stages during construction of the fill, a long arched extension tongue has been used to connect a standard two-section sheepsfoot roller directly to the tractor drawbar. The tractor is backed to the top of the slope, the roller being let down over the edge, and the required number of round trips are made by moving the tractor forward, away from the top of the slope, and back, for a distance equal to the length of the tongue.

An advantage of this method is that the tractor and roller may be used for compacting fill material without rerigging during the period while the fill is being built up to the next stage.

No Great Problem

Rolling flatter slopes offers no great problem. Equipment can often work directly on the slope, and a standard two-section sheepsfoot roller hitched directly to a tractor has been used to roll the slope longitudinally.

A truck crane has also been used to roll low cut and fill slopes lengthwise. Two cables are attached to the roller,

one to control the position of the roller on the slope and the other to pull it. Care must be taken with this method so that the axis of the roller is at right angles to the direction of the pull, since a skewed roller has a tendency to pick up straw from the surface of the slope.

High fill slopes can be effectively rolled with a heavily weighted two-section sheepsfoot roller, provided a cable winch of sufficient power and braking capacity is available. A truck crane has proved very efficient for rolling slopes of as much as 300-foot length in the mountains of Southern California.

After straw is spread, the roller, connected directly by cable to the winch, is stationed at the top of the slope and allowed to roll to the bottom by its own weight, the speed of descent being controlled by the winch operator. It is then pulled back to the top of the slope and the cycle repeated until the required number of round trips of the roller have been made. The crane boom cable is then hooked to an eye attached to the roller frame, the roller hoisted free of the slope, the truck moved forward a distance equal to the width of the roller, the boom cable unhooked, and the rolling resumed.

Brush is placed in gullies before backfill material is spread on slope face. Note log and brush crib at toe of fill. (Near Weaverville, Trinity County)

REPAIR OF FAILURES ON NEWLY STABILIZED SLOPES

A few failures are almost inevitable during the first winter after installation of any type of slope stabilization treatment. The extent and seriousness of these failures is usually directly related to the intensity of the first storm of the season, which occurs before vegetation has started growth and before the soil has become completely consolidated. Prompt and effective repair of sections which have failed is extremely important, since no further loss of soil then takes place and the repaired area becomes stabilized during the remainder of the rainy season.

The most frequently observed type of failure is surface slippage. If the slip starts at the top of the slope or near the top, it is likely that seepage or percolation of water from above through a porous layer of subsoil is causing the damage. This percolation may be intensified by standing water in a poorly graded intercepting ditch or leakage through cracks in a paved shoulder or drainage ditch. Small amounts of runoff water of insufficient quantity to cause gullying may also cause this type of failure. Since saturation in this case is caused by water which originates elsewhere than on the slope face, a necessary preliminary to repair is correction of the defective drainage condition.

Causes of Slips

Slips which start on the lower two-thirds of the slope, or below, are usually caused by saturation of the soil due to lack of sufficient compaction before the rains start. On cut slopes, insufficient roughening of the subsoil before topsoil is applied sometimes increases the tendency toward slippage. Since this condition cannot be corrected after the slippage has occurred, and since rainfall which has caused the damage has also compacted the portions of the slope which have not failed to the point where further failure is unlikely, corrective operations can be restricted to simple repair.

If failures appear on cut slopes which have been given Type "C" stabilization treatment, the area from which surface soil has slipped need not be backfilled with topsoil as part of the repair process. Sufficient topsoil particles are usually left to support some plant growth, and a replacement layer of topsoil would be subject to the same conditions which caused the original failure. Furthermore, any cultivation of the exposed subsoil is considered unnecessary, since loose soil would then be subject to saturation and possible loss.

Repairing Slip Damage

The most economical and satisfactory method for repairing surface slips has proved to be fertilization and heavy seeding of the exposed subsoil and the application of a straw mulch, held in place, if necessary, by a few shovelfuls of loose soil. The sooner this method is employed, after failure, the better, since moisture already in the soil will germinate the seed and the straw covering will retard further soil loss. Cereal grain seed is used for this purpose because it will germinate quickly and successfully beneath a straw mulch, is easily obtainable, and is inexpensive. This treatment may be supplemented by planting cuttings of ground cover plants or shrubs.

Extensive gullies sometimes appear on highway slopes, caused by a concentration of runoff water from above due to berm failure, plugged downdrains or inadequate diversion ditches. After the condition causing the concentration of water has been corrected, moderate-sized gullies may be repaired as described above. If the gully threatens the traveled way, backfilling is sometimes necessary, and in

Reworking fill slope face with bulldozer and installing brush layers. (Near Weaverville, Trinity County)

this event care should be taken that the backfill material is well compacted during application.

Rills which develop on a recently constructed slope which has not been covered with straw may be treated with seed alone, or straw and seed if the soil appears to be extremely erosive.

Since most of these repaired areas do not fail during the storm following treatment, the necessity for repair work lessens year by year, until complete control is established.

REPAIR OF OLD ERODED SLOPES

Light cultivation of the compacted soil is a necessary preliminary to successful repair of old eroded slopes which do not require rebuilding. If seed is sown on uncultivated and gullied soil, the seed tends to concentrate in pockets in the bottoms of the gullies, and a large proportion rolls to the bottom of the slope and is lost. The cultivating operation creates a more favorable condition for seed germination, and also smooths out irregularities and breaks up channels of concentration in the gullied slope.

Cultivation should be followed by fertilization, seeding and the application of an adequate straw mulch. Thereafter, the slope should be given routine maintenance, repairs being made as soon as failures become evident.

On soil slopes, it has not been found necessary to tie the straw covering down with pegs and twine or wire to prevent serious loss by wind action. In a few days the unsecured straw blanket seems to settle and mat and is then able to withstand winds of considerable velocity without damage. This settling may be accelerated and seed germination hastened by sprinkling the straw with water after spreading. As soon as the seed germinates the straw is held securely in place, so the cost of pegs and ties simply to prevent possible loss of straw between the time of application and the time of seed germination is not considered justified. A large quantity of straw can be replaced for the cost involved in holding the blanket in place mechanically.

Storms Present Problem

Successful repair work on old eroded fill slopes in localities subject to storms of high intensity, as in the mountains of Southern California, is likely to be a long-term proposition. If the seasonal rainfall is favorable during the first year after installation, almost complete control is possible with a treatment consisting of cultivation, fertilization, straw mulch, grain seed and a thick planting of willow or Baccharis viminea cuttings. If heavy storms come before the seed and cuttings have become established, failure of portions of the treated slope can be expected, the extent of failure being dependent upon the intensity of the storm. A continuing program of failure repair is, therefore, necessary until vegetation has become completely established, after which time maintenance activities can usually be restricted to correction of defective drainage conditions as they appear.

The present-day cost of labor is so high that hand smoothing of slopes and installation of wattles is not considered economically feasible. The less elaborate methods of treatment described above are believed to be as effective in the long run if proper maintenance is forthcoming, and are certainly much cheaper to install than the wattle treatment.

Treatment of Slipouts

Large gullies or slipouts in fill slopes require more extensive treatment, since it is usually necessary to replace the material which has been lost in order to safeguard the roadbed.

The accompanying illustration shows a slope which is so badly gullied that repair is necessary. This soil, when dry, sets up so hard that it is almost impossible to walk on the slope. It is obviously unreasonable to assume that loose soil, end dumped upon a slope like this and given no further treatment, can be expected to remain in place during the following rainy season. Compaction or the utilization of some means of keying the loose backfill material to the slope surface until consolidation has taken place is essential in order to insure effective repair.

If maintenance funds are restricted, and gullies are not too large, the repair method can be relied upon to provide control in from two to three seasons.

A crib of logs and coarse brush is constructed at the toe of the fill in order to provide a solid foundation against which backfilled material can settle. Loose brush is then placed in the slope gullies and covered with a moderately thick layer of backfill material. Additional brush is spread over the surface and covered with soil. This process is repeated until the original fill contour is restored. Surface protection of the type justified by the soil and locality is then applied, and seed and cuttings of suitable plants are planted during the following planting season.

Backfill Material

Since the backfill material is not compacted by this method, we must

expect saturation, settlement and even slumping, to the extent allowed by the consolidating influence of the buried brush, during the rainy season following treatment. The area affected by this settlement is usually near the top of the treated section, however, and can be backfilled and treated as described above without disturbing the growth of vegetation on the unaffected portion of the slope. A third treatment, following the next rainy season, is sometimes necessary in order to compensate for further settlement of the backfill material, but under average conditions very small areas are involved and the cost is not high.

If gullies are so large and the danger to the roadway so great that the fill slope must be fully restored immediately, the method illustrated here is recommended.

CONCLUSIONS

The most successful erosion control methods have proved to be those which reproduce most closely conditions which are to be found on natural slopes. Mechanical or unnatural methods of control, while sometimes immediately effective, deteriorate with time and show up poorly in the long run as compared with methods that follow natural vegetative processes. If we work with Nature, erosion control problems are simplified and the probability of success becomes more certain than if we disregard the examples of successful natural stabilization to be found on every hillside and proceed to attack the problem from a mechanical angle.

By artificially speeding up the stabilization process, thereby creating conditions in one season which Nature could not duplicate in several years, we find that we can shorten the time required for complete control.

Much of the value of slope stabilization treatment is lost unless proper maintenance can be given during the all-important first and second years after installation, and as required thereafter. Cost of timely maintenance is not high, but neglect can bring about increased and unnecessary expenditures due to the necessity of cleaning gutters and repairing gullies which threaten the traveled way, and of frequently rebuilding portions of roadways at fill locations.

Flatter Slopes Favored

Highway construction standards now encourage the use of flatter slopes in erosion-prone soils. Flatter slopes allow the use of thicker blankets of topsoil which can support a more vigorous growth of vegetation without tending to slump when saturated. Control problems are eased considerably, and the need for maintenance reduced.

As new successful erosion control projects are completed and the consequent reduction in maintenance cost for repair of erosion-caused damage becomes more evident, highway employees are taking a greater interest in the program. Highway engineers have been particularly cooperative in developing methods which would be both practical and effective, and highway maintenance forces have become more conscious of the value of prevention. There is still a decided need for continued educational work, however, especially in regard to effective methods for repair of old eroded slopes, and it is believed that eventually this work will be done as a matter of course.

Work Will Continue

Experimental work will be continued. Even though it is felt that considerable progress has been made, too many questions remain unanswered and too many partial failures result from high-intensity rains to allow us to believe that the most effective methods have yet been developed.

This method involves reworking the entire outer surface of the affected portion from the bottom up. A log and brush crib is first constructed at the toe of the fill to offer a solid foundation against which the soil can be compacted. Backfill material is furnished from the top, and a tractor equipped with a bulldozer is used to spread, compact and shape this material to the original fill contour. Brush layers are installed at suitable intervals as the fill is built up. (See brush layer method detail sheet.) The completed slope is then given surface protection, including a thorough rolling, if possible, and suitable seed, plants and cuttings are planted at the proper time.

THE END

Reprints of the entire series of articles by Mr. Bowers, including specifications, will be available at an early date.

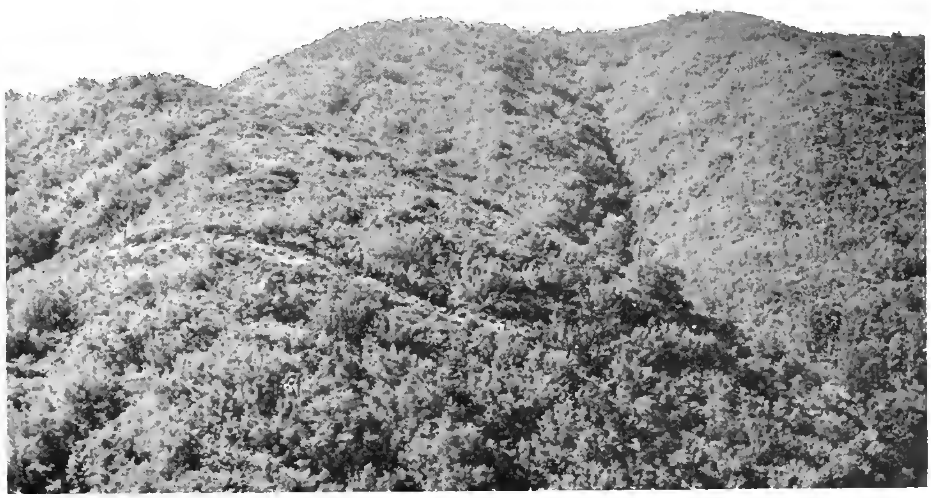
ACKNOWLEDGMENTS

Grateful acknowledgment is hereby made to the many persons who, by their suggestions and encouragement, have contributed to the preparation of this booklet.

Special acknowledgment is due Mr. Chas. C. Morris, Division Engineer of the Public Roads Administration, for suggesting that a publication describing our erosion control methods would be of interest to others faced with similar problems; and later for his review and suggested improvements in the manuscript. Also to Mr. Wilbur H. Simonson, Chief, Roadside Section, Public Roads Administration; Mr. C. J. Kraebel, Division of Forest Influences, U. S. Forest Service; Mr. J. S. Horton, San Dimas Experimental Forest, U. S. Forest Service; Professor Joseph Kittredge, Professor of Forestry, Forest Influences, University of California; and Mr. C. H. Gleason, Forester, U. S. Forest Service, for their valuable suggestions and constructive criticism; and to Mr. L. S. Manning, Associate Landscape Architect, California Division of Highways, for his compilation of this manuscript.

H. DANA BOWERS

Nature's way. A completely stabilized slope



Black Point

Improvements on Sign Route 37 Look To Future Four-Lane Divided Highway

By CHAS. SCHEMEL, Resident Engineer

The first seven miles of State Sign Route 37, known as the Black Point Cut-off, runs in a northeasterly direction from the Redwood Highway, U.S. 101, at Ignacio in Marin County, to a junction with the Sears Point Cut-off, State Sign Route 48, at Sears Point.

From this junction the Black Point Cut-off branches off northerly to the Sonoma and Napa Valleys, while the Sears Point Cut-off branches off in an easterly direction toward Vallejo and the American Canyon Route to Sacramento and interior points.

This seven-mile section of the Black Point Cut-off, therefore, carries the full traffic load bound to and from the Golden Gate Bridge and Marin County to the Sonoma-Napa-Vallejo areas and beyond.

Commuter traffic to the U. S. Air Force base at Hamilton Field in Marin County, and the Mare Island Navy Yard base at Vallejo, add considerably to this traffic.

Road Graded in 1916

This section of road was originally graded to a width of 24 feet in 1916, that portion over the tidelands being constructed from material excavated from borrow pits immediately adjacent to the roadbed. An 18-foot width asphalt concrete pavement was placed on this grade in 1922.

The section of the old road through the foothills near Black Point in Marin County, and near Sears Point in Sonoma County, contained limited sight distances and steep grades which were standards at that time.

With the construction of the Golden Gate Bridge and general development of the North Bay area, the steep grades and sharp curvature, with limited sight distances, caused serious traffic congestion on this section of roadway.

The deep borrow pits paralleling the roadway also added to the accident hazard.

UPPER—Son-208-A. Shoulder widening on Sears Point Cut-off from excess excavation. LOWER—Son-8-A. Junction Black Point and Sears Point Cut-offs on relocated line looking north. Old road on right

In preparation of the 1948-49 Budget, the improvement of portions of this route was given favorable consideration by the California Highway Com-

mission, and funds were voted for improvement of that portion of the route between Ignacio and the Petaluma Creek Bridge in Marin County.

Funds for that portion of the route from the Petaluma Creek Bridge to the Sears Point Junction in Sonoma County were included in the 1949-50 Budget.

The improvement of the section in Marin County was let to contract construction in December, 1948, Parish Brothers of Benicia being the successful bidders.

This contract consisted of a relocation of the road through the range of hills just west of Petaluma Creek, where a cut 100 feet in depth required moving some 350,000 yards of earthwork to construct the grade.

Steep Grades Eliminated

The roadbed was graded for a four-lane divided freeway section, of which two lanes 0.8 mile in length on the new location were surfaced to accommodate present traffic.

Surplus material from the excavation was used to construct the embankment for two additional lanes of a future four-lane divided freeway across the 2¼-mile marshland area between Ignacio Wye and the foothills.

While this new location is only 0.1 mile shorter than the old road, it eliminates steep grades and the 200-foot radius curve at the westerly approach to the Petaluma Creek Bridge.

Work on this contract was completed in January, 1950, at a cost of $526,000, of which $116,000 was for purchase of right of way and for clearance of utilities and obstructions.

A second contract, covering the work from Petaluma Creek to Sears Point Junction, was started in October, 1949, by Piambo Construction Company of San Francisco, and will be completed in the fall of 1950.

Future Four-lane Highway

The work in general is similar to that completed in Marin County, material from the 75-foot cut near the northeasterly end of the project being used to construct the roadbed for future development of a four-lane divided roadway across the 2.7 miles of reclaimed tidelands to the southwest.

The new alignment through the hill at Sears Point will be paved to provide a four-lane divided highway 1.2 miles in length, with a six-foot minimum curbed division strip and a channelized intersection at the junction of the Sears Point Cut-off.

The 4.6 percent maximum grade and 5,000-foot radius curve replaces the existing 6.5 percent grade and several 500-foot radius curves and long sections of nonpassing sight distance.

The plant-mix pavement on both of these projects is placed over a cement treated base.

The excavation from this relocation also provides sufficient material to permit widening of the narrow shoulders on the Sears Point Cut-off from their existing 3-foot width to a 10-foot width, between the Sears Point Junction and the district boundary at Sonoma Creek.

The Sonoma County project is estimated to cost $684,000, of which $84,000 is for right of way and clearance of utilities and obstructions.

UPPER—Completed section of Black Point Cut-off, Mrn-1-A, looking north. Graded section for future divided freeway on the left. LOWER—Completed section of Black Point Cut-off, Mrn-1-A, looking north at new approach to Petaluma Creek Bridge

New Freeway

Unit Between Cottonwood and Redding In Shasta County Is Dedicated

One of the main events of the Shasta County Centennial Celebration, marking 100 years of progress in Shasta County, was the dedication of the new limited access freeway on Pacific Highway U. S. 99 between Cottonwood and Redding.

At a ceremony on June 15th sponsored jointly by the chambers of commerce of Redding, Anderson and Cottonwood, Frank B. Durkee, Deputy Director of Public Works and guest of honor, officially dedicated this modern highway which will be completed this year at a total cost of more than three million dollars.

In connection with the dedication ceremony prior to the ribbon cutting, close to 200 local citizens attended a luncheon at the Anderson Fairgrounds honoring Mr. F. W. Haselwood, recently retired district engineer. Included among the luncheon guests were state, county and city officials, members of the various local chambers of commerce and service clubs, and prominent civic leaders.

William A. Quinlan presents to F. W. Haselwood, retiring District Highway Engineer, a resolution adopted by the Redding Chamber of Commerce commending him for his long service

Gillis Principal Speaker

Assistant State Highway Engineer R. M. Gillis was the principal speaker, and in paying tribute to Mr. Haselwood, traced his entire 38-year career with the State, and pointed out his foresight in the planning of the Cottonwood-Redding Freeway. He told of the tremendous growth in population and motor vehicle registration in the State during this period, and mentioned with pride the fact that California is second to none in modern highway development. He stated that since 1932, when Mr. Haselwood came to District II, there has been spent within the district \$19,000,000 on highway maintenance and \$40,000,000 on new developments.

As one of the highlights of the luncheon William A. Quinlan, Chairman of the Roads and Highways Committee of the Redding Chamber of Commerce, on behalf of the chamber of commerce presented Mr. Haselwood with a framed resolution commending him on his faithful service and many fine achievements. Mr. Haselwood replied that, after having performed work that he liked for 38 years, it was very gratifying to find out that so many people liked what he had done.

Trask New District Engineer

Senator Edwin J. Regan, from Trinity County, in a brief address introduced Mr. James W. Trask, successor to Mr. Haselwood as district engineer. Mr. Trask expressed the sincere hope that the new highway being dedicated would successfully fulfill one of its main objectives, the reduction of accidents and a saving of lives.

The dedication of this section of highway was a very fitting ceremony in connection with the centennial celebration. Almost the entire length of the project lies within the old Rancho San Buenaventura, an original Spanish land grant to Major P. B. Reading, early pioneer and prominent figure in Shasta County history during the 1850's. It was in Clear Creek, not far from the site of a modern bridge on the new project, that Major Reading first discovered gold in Shasta County in 1848. This new multilane divided highway is indeed a far cry from the old California-Oregon road, main artery of travel of the pioneers and established by them

in the 'fifties. The present highway crosses this old pioneer road in the vicinity of Spring Creek north of Anderson, where evidence of the historical wagon road is still visible.

The first unit of construction between Cottonwood and Anderson was completed in December, 1948. (See article in March-April issue of *California Highways and Public Works*.) The second unit, completed in June this year, included construction of a four-lane divided highway and a 32-foot wide frontage road through the Town of Anderson, and construction of the southbound lanes between Anderson and Clear Creek, midway to Redding. The accompanying article by W. Z. Hegy, resident engineer, describes construction of this unit.

The third and final unit now under construction includes reconstruction of the existing highway between Anderson and Clear Creek to form the northbound lanes, and construction of an additional bridge across Clear Creek and widening of the existing bridge. The completed facility will provide a modern four-lane divided limited freeway for the total 12 miles between Anderson and Redding, and will be a welcome relief to the motorists who have been traveling the old narrow and very congested road between these two rapidly growing towns.

No Parking

Continued from page 6 . . .

not take effect for 30 days, most drivers obeyed it in advance. Within a few days, the number parking along the street was noticeably less and that number steadily dwindled through the waiting period. After the signs were installed, obedience has been almost universal, and the need for enforcement slight. During the first month, police issued nothing but warning citations and surprisingly few of them. In all respects the change has met with almost universal public favor.

Driving tests made before parking was prohibited indicated an average speed of 23 miles per hour through the entire length of the 46-foot wide street, with the most congested section having an average speed as low as 19 miles per hour. Later tests, without

. . . Continued on page 53

Construction of Freeway Section on U. S. 99 Between Anderson and Redding Completed

By W. Z. HEGY, Resident Engineer

As an additional step in the improvement of Pacific Highway U. S. 99 between Cottonwood and Redding, a highway contract is approaching completion which will replace the present two-lane highway constructed in 1921 between Anderson and Clear Creek.

The project begins at the southerly limits of Anderson and parallels the existing road on the east side to Clear Creek for a total distance of six miles.

The contract is the second in a series of three construction projects which will replace a narrow and obsolete highway between Cottonwood and Redding.

The original pavement was placed by H. J. Kaiser Construction Company in 1921 and consists of a bar-reinforced Portland cement concrete slab 15 feet wide with subsequent widening with three-foot plant-mixed shoulders.

Maintenance Problem

The pavement has withstood usage remarkably well, considering the lack of subgrade material of good bearing value, the pavement, in general, having been laid on roadway subgrade consisting primarily of clayey material.

However, the heavy loads applied by commercial vehicles comprising freight transports, lumber trucks and logging trucks hauling to local mills have created a problem of daily maintenance on the concrete and subsiding shoulders.

In addition, the highway facility has become inadequate to provide unrestricted flow of traffic which has increased from a daily volume of 3,700 vehicles in 1940 to a present-day volume of 8,500.

The project consisted of constructing a graded roadbed, placing imported borrow to a minimum depth of 1.25 feet, constructing a six-inch thickness of cement-treated base and placing a three-inch course of plant-mixed surface of open-graded and dense-graded material.

In general, the terrain is level and opportunity for drainage development poor.

Seepage From Canal

Approximately paralleling the highway project for its entire length is the main canal of the Anderson-Cottonwood Irrigation District. This canal lies

Completed section of new freeway in Anderson. Frontage road on left

This is another completed section of the freeway in Anderson looking south, with frontage road on right

on higher ground than the highway and consists of an unlined channel, substantial portions being uncompacted embankment sections.

The resulting seepage from the canal during the irrigating period that extends from April to November saturates the adjoining land to the extent that, during construction operations, the water table was encountered in the subgrade one to two feet below the natural ground surface.

In addition, irrigation runoff from the abutting ranches, which was formerly handled by an intercepting ditch westerly of the old highway, flooded grading operations at a time of year when ideal ground conditions for grading are normally anticipated.

Drainage System

The result was that a greatly expanded drainage system had to be provided and subdrains placed longitudinally under the roadbed through many sections to protect the newly constructed highway. A total of 9,700 lineal feet of subdrains, ranging from 12 to 24 inches in diameter, was placed to draw off ground water from the subgrade.

Irrigation canal under construction

Irrigation canal completed

The southerly portion of the contract lies in the Town of Anderson; in this vicinity, for a length of 3,000 feet, has been constructed a limited-access freeway.

On the east the highway is paralleled by the Southern Pacific Railroad.

Seven business blocks fronted the existing highway on the west side, four of which were highly developed.

Through these seven blocks a limited-access highway was constructed which provided two lanes for northbound and two lanes for southbound traffic with eight-foot emergency parking shoulders.

. . . Continued on page 49

U. S. Job

Improvement of U. S. 50 From Meyers to Mays in Lake Tahoe Area Under Way

PROJECT California Forest Highway 32-L, Placerville - Lake Tahoe, now under way, covers the construction to modern standards of a part of U. S. Highway 50, a main transcontinental highway. The project begins about ¾ mile west of Meyers, California, at the foot of the recently completed "Meyers Grade" and extends in a northerly direction approximately 5.0 miles to Mays, commonly known as Tahoe Valley Wye.

The proposed improvement consists of grading, placing 4-inch compacted base course, and 3-inch compacted bituminous plant-mix surfacing with flush seal coat. The roadbed is being surfaced to a width of 32 feet which will provide two 11-foot traffic lanes and 5-foot shoulders. Location survey for the project was made during the summer of 1944. The alignment for the new highway traverses relatively easy, flat to rolling terrain permitting high standards for alignment and grades. Minimum radius curve is 900 feet and maximum grade is 5 percent. Minimum nonpassing sight distance is 370 feet. These standards will permit safety at normal maximum driving speeds.

Under joint agreement between the California State Highway Department, U. S. Forest Service, and U. S. Bureau of Public Roads, funds for the construction of the project were programed from Fiscal Year 1951 Federal Forest Highway funds. The project was advertised by the Bureau of Public Roads on April 17, 1950. Bids were opened on May 9, 1950. Six bids were received ranging from the low bid of $148,801.40 submitted by Harms Brothers, contracting firm from Sacramento, to a high bid of $212,928. The contract for construction of the project was awarded to Harms Bros. and contract time began on May 23, 1950. Work in progress at present consists of clearing and some grading work. It is expected that the contractor will complete the contract during the 1950 season. Construction work is under the supervision of Chas. C. Morris, Division Engineer, Bureau of Public Roads, U. S. Department of Commerce. W. H. Baugh, Public Roads' engineer, is resident engineer on the project.

The improvement of the Meyers to Mays section of the Placerville-Lake Tahoe road will replace a low standard hazardous section approaching Lake Tahoe which carries heavy traffic particularly during the summer months not only from transcontinental travel but from local residents in the Tahoe Valley Lake area.

Construction is under way for the improvement of U. S. 50 from the foot of Meyers Grade to Mays, a cooperative project of the U. S. Forest Service, U. S. Bureau of Public Roads, and State Division of Highways. Lower photo shows existing highway on left, realignment on right

Hollywood

Continued from page 18 . . .

geles *Times* and his photograph of this event is reproduced.

When these two contracts, as described in this issue by the two resident engineers, have been completed as anticipated in December of this year, it will be possible to open the Hollywood Freeway to public traffic for a distance of 3½ miles between Grand Avenue and Silver Lake Boulevard. When this is done, public traffic will then be utilizing the highest level of the four-level grade separation structure. Other levels of this bridge will come into use later as future connecting construction with the Arroyo Seco Freeway and the Harbor Freeway is carried out.

Freeway Law

Continued from page 33 . . .

solely from traffic regulation under police power."

After reviewing cases submitted by the plaintiffs in support of their contention, the appellate court, speaking through Associate Justice Mussell, distinguished them from the Bakersfield situation in the following language:

"In all of the foregoing cases in which it was held that compensation must be paid there was either physical injury to an owner's property itself, as in the *Reardon* case, or a physical impairment of access from the property to the street, whether caused by change of grade, as in the *Eachus* cases and the *Rockridge* case, or by physical impairment of the property to the street by the means of the construction of a physical barrier as in the *McCandless* case, or by removing the property from the through highway and placing it on a side or service road as in the *Ricciardi* case, or by the creation of a dead end street as in the *Bacich* case. None of these cases involve the division of a highway into separate roadways by concrete islands or division strips and all are factually different from the case at bar. In this connection, it should be noted that the rule that reasonable modes of egress and ingress embrace access to the next intersecting street as announced in the *Bacich* case, supra, is not applicable here for plaintiffs have access to Brundage Lane, the next intersection to the south, and to First Street on the north, adjoining their property."

The only previous California decision wherein the facts were found by the Fourth District Court to be comparable to the Bakersfield situation was the case of *Beckham* v. *City of Stockton*, 64 Cal. App. 2d 487. The subway therein involved, the court said, "acted, in effect," as the State had contended, "as a center dividing barrier and necessitated a certain amount of additional travel * * * from plaintiffs' properties."

Presiding Justice Adams of the Third District Court, in her opinion in the *Beckham* case, had held that this constituted "mere inconvenience and circuity of travel" and constituted "no grounds for the recovery of damages." This holding Justice Mussell cited as supporting his opinion that the center barrier at Bakersfield constituted no actionable damage.

"The facts alleged in the instant action," Justice Mussell said, "indicate that the real basis of plaintiffs' claim is diversion of traffic from their business." However, the applicable rule is, he said, quoting from *Rose* v. *State of California*, 19 Cal. 2d 713, 737:

"The damage suffered by plaintiffs is, as we have seen, the interference with their right of access. The diversion of traffic is not a proper element to be considered in computing those damages inasmuch as a landowner has no property right in the continuation or maintenance of the flow of traffic past his property."

"It seems quite clear," the justice continued, "that the division of a highway is an exercise of the police power being directly intended for the public safety." And he went on to point out that "damages resulting from the exercise of police power are not compensable," citing *Simpson* v. *City of Los Angeles*, 4 Cal. 2d 60.

"Statutory authority for a center division strip, such as that under consideration in this case," he said, "is found in Section 144 of the Streets and Highways Code. Under that section the State Highway Engineer is authorized to divide or separate any state highway into separate roadways whenever there is particular danger to the traveling public of collision between vehicles proceeding in opposite directions or from cross traffic by constructing curbs, central dividing sections or other physical separations, or by signs, marks or other devices in or on the roadway appropriate to designate the dividing line."

Statements of Mr. Justice Edmonds and Mr. Justice Traynor in the *Bacich* case, 23 Cal. 2d 343, were quoted in further support of the conclusion that the Bakersfield situation involved only an exercise of the police power and, as such, was not actionable.

The court disposed of the question of the plaintiffs' access to their property with this statement:

"The facts pleaded herein show that the highway upon which plaintiffs' property abuts is not closed and that plaintiffs, once on the highway to which they have free access, are in the same position and subject to the same police power regulations as every other member of the traveling public. Because of a police power regulation for the safety of traffic, they are, like all other travelers, subject to traffic regulations. They are liable to some circuity of travel in going from their property in a northerly direction. They are not inconvenienced whatever when traveling in a southerly direction from their property. The rerouting or diversion of traffic is a police power regulation and the incidental result of a lawful act and not the taking or damaging of a property right."

Center Strip Upheld as Safety Regulation

The court then concluded that "If the contention of the plaintiffs herein is sustained, the right of the State to control the traffic as a safety regulation would be definitely curtailed and traffic islands or double lines in the highway to separate through traffic would be prohibited. The damage of which plaintiffs complain would be the same if no division strip had been constructed on the highway in question but that double white lines had been painted on the highway and a 'no left turn' sign had been erected, or if the entire highway had been designated as a one-way street.

"We conclude, therefore, that the plaintiffs failed to state a cause of action in their amended complaint and the judgment is, therefore, affirmed."

Mr. Robert E. Reed, presently Chief Counsel for the department, argued the case before both the superior court and the district court of appeal, and Mr. Harry S. Fenton, of the legal staff, did work on the brief.

The importance of the decision of the district court in *Holman* v. *State*, will be more fully indicated as the highway program progresses. The right of the public to provide for safety on its streets and highways and to regulate traffic by the placing of physical barriers within streets and highways, as authorized by existing legislation, is, of course, fully validated. Ordinances

. . . Continued on page 54

Something New

Bridge Department Develops Portable Pile Testing Rig

By G. C. SMITH, Associate Bridge Engineer

In order that a quick economical method of making load tests on piles might be had the Bridge Department of the Division of Highways developed a convenient lightweight testing apparatus. The new equipment, already successfully used on several other jobs, was recently used to make load tests on some drilled-in piles in the Imperial Valley.

Eighteen reinforced concrete slab bridges were being built on Route 187 which follows up the east shore of the Salton Sea.

All of the bridges were founded on drilled-in piles consisting of reinforced concrete columns poured in 14-inch diameter holes drilled in the ground. The foundation in this locality was suited admirably to this system and the holes stood perfectly after drilling.

NEW TECHNIQUE

This technique represented a definite departure from piles previously used by the Bridge Department. No pile driving was done. The only equipment necessary was that used in drilling the holes. This consisted of a truck-mounted gasoline-powered auger-type earth drill capable of drilling holes to a depth of about 22 feet. All piles penetrated at least 15 feet below channel grade. Standard reinforcing for cast-in-place piles was used throughout. Pile extensions were poured in 14-inch diameter steel forms which extended from the ground line to the cap. The design load is 20 tons per pile.

To determine the actual load-carrying capacity of these piles, two load tests were made with the new equipment.

At two sites, one where the specified pile penetration was 20 feet below channel grade, the other, where penetration was 15 feet, two additional piles to be test loaded were drilled and poured, each midway between two plan piles. The test piles were reinforced similar to plan piles. However, the two piles on either side of the test piles, used as anchors for the jacking truss, were each additionally reinforced

UPPER—Pipe drilling rig in operation. CENTER—Detail at anchor piles. LOWER—Test load apparatus. Truss and jack in place

with four 1-inch bars. These bars extended from the tips of the piles to approximately 2 feet above cut-off. The protruding bars were bent over and around the fins of the truss base and welded one to another.

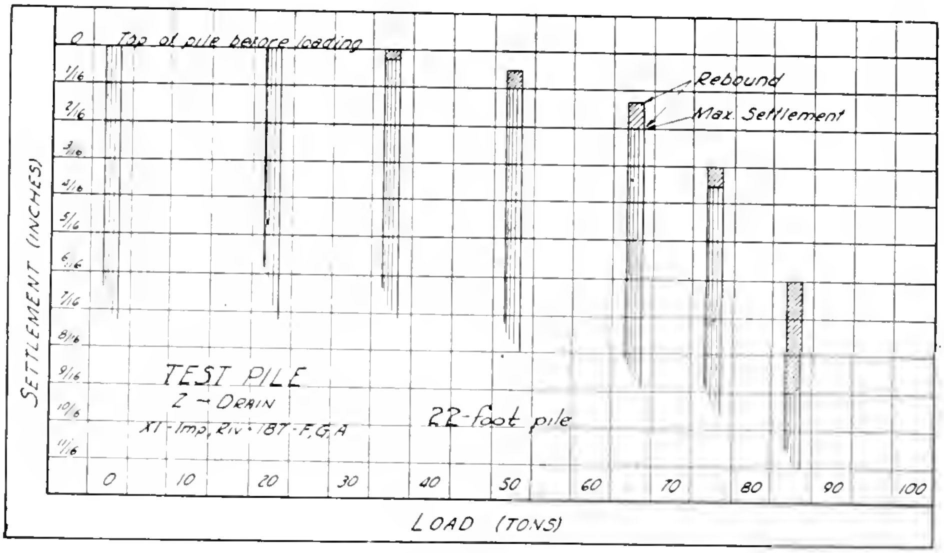
LOAD TESTING EQUIPMENT

The pile load testing equipment was operated by Bridge Department personnel. This equipment consists of (1) a pin-connected steel truss which is used to transfer reaction loads to the two anchor piles; (2) a hydraulic power unit; and (3) a 115-ton capacity hydraulic jack. Details of the truss are shown in the accompanying photograph.

Truss and hydraulic jack on test pile

The hydraulic power unit is a self-contained high-pressure constant-pressure system designed for field use and powered by a 5-kw. gas engine driven generator. A 3-h.p. motor geared to give a shaft output of 270 rpm is directly connected to a rotary piston type hydraulic pump capable of a maximum pressure output of 3,000 psi. Discharge from the pump is piped to a manifold. Connected to the manifold are:

1. A 3,000 psi nitrogen loaded accumulator cell which is preloaded to 1,000 psi.



Settlement and rebound, Z-Drain

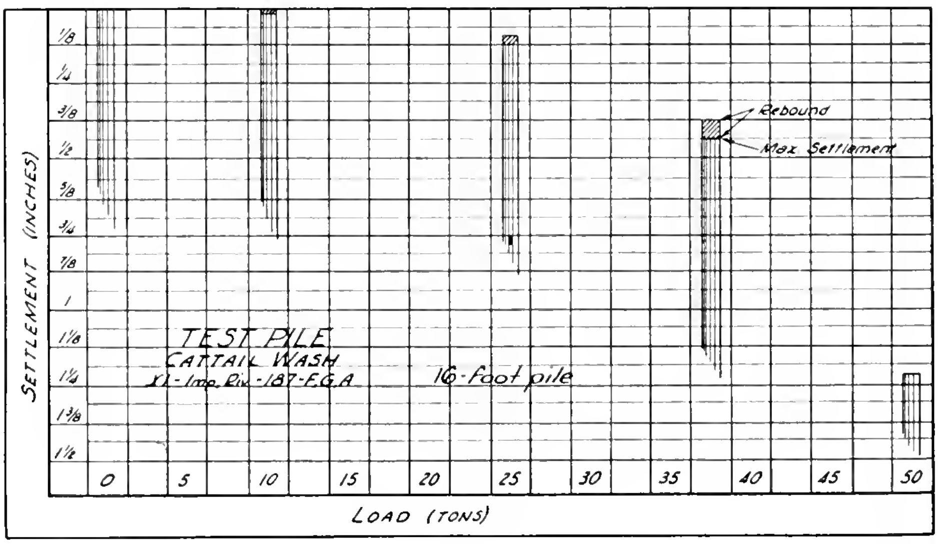
2. A close pressure differential mercury switch.
3. A 4,000 psi gage.
4. A 3,500 psi overload relief valve containing a relief valve port leading back to a reservoir tank.
5. Pressure outlet lines leading to a 4-way control valve by which pressure may be diverted to either side of the piston of the double acting 115-ton hydraulic pressure cell.

CONSTANT LOAD MAINTAINED

The purpose of the nitrogen loaded accumulator is to maintain a constant load even though slight pile settlement occurs. This enables the equipment to be brought to proper load and left without constant attention to maintain an even hydraulic pressure at the loading cell. The pressure switch may be adjusted to hold the pressure within a 150-pound range. The maximum pressure that may be developed through the mercury switch is 2,500 psi. Two level gages are mounted on the power unit to insure leveling of the mercury switch. The 4,000 psi gage is used as a cross-check on the mercury switch and for setting the switch accurately. A needle valve with a lead-off line is incorporated in the 3,500 psi overload relief valve and is used for controlling pressures between 0 and 1,000 psi.

The 115-ton pressure cell is a double-acting hydraulic jack having a 103.87-square-inch piston area and a 4-inch stroke. The barrel and main base of the cell are steel; the piston lock-ring, and

Settlement and rebound, Cattail Wash



two self-aligning plates are of aluminum.

SIMPLICITY AND ECONOMY

The equipment features simplicity and economy in both its application and operation. The application of load, subsequent removal to measure rebound, and reapplication of load takes only a few minutes contrasted to hours required when loading with either liquid or solid weights. The accompanying charts illustrate the result obtained in the two tests. Failure occurred in the 22-foot pile at Z-Drain under a load of 75 tons while the 16-foot pile at Cattail Wash was considered to have failed at 35 tons.

The surface soil mantle throughout this area consists of a few inches to a few feet of gravelly clay and gravelly fine sandy clay. This is underlain by a hard silty clay generally referred to as Imperial clay. Power borings were made throughout the area during March, 1949, at which time preliminary foundation studies were being made for this project. Drilled holes on two or three occasions were extended to depths in excess of 50 feet without penetrating below the Imperial clay.

IMPERMEABLE CLAY

With the exception of a few thin layers of volcanic ash encountered in the deeper borings, the clay sediment was essentially uniform in character. Two-inch undisturbed samples were taken and unconfined compressive strengths measured in the field. These tests indicated that the clay sediment had an average shear strength of approximately 3,500 pounds per square foot at moisture contents ranging between 12 percent and 15 percent (dry weight). Unconfined compressive strengths up to two tons per square foot were measured at depths of three to five feet below stream beds at drainage and irrigation ditch sites. Such values attest to the impermeable nature of the clay sediment since water had been flowing in certain of these channels for many months prior to this study.

Under three recent contracts, a length of about 26 miles along the east side of the Salton Sea north of Niland is being improved to two-lane width. Ninety posted bridges, many with only a 10-foot roadway, have been eliminated or replaced.

Reynolds & Thomas, and E. L. Yeager Company were contractors on the respective contracts, with Macco Corporation as subcontractor, drilled the piling. The hydraulic load-testing apparatus was built for the State by the Garrison Manufacturing Company of Los Angeles. D. C. Smith was resident engineer for District XI, and G. C. Smith served as Bridge Department representative on both contracts.

Freeway Construction

Continued from page 44 . . .

Traffic flow is divided by a 20-foot curbed median strip with allowance for turning lanes at crossovers. On the westerly side, the entire business frontage was moved back to permit construction of a 32-foot frontage road, separated from the southbound lanes by a curbed median strip 24 feet wide and provided with four access openings to the southbound lanes.

Outer Highway

The removal of business establishments to provide for the additional right of way required for outer highway construction involved moving and resetting existing buildings; in most cases, however, buildings of frame construction, of ancient vintage and of poor foundation were demolished and in their places are rising modern buildings of adequate construction including two large multiple business units of reinforced concrete.

The remarkable improvement to this frontage has been the incentive to a ropid development of formerly vacant portions of the entire seven blocks.

On the upper limits of the project for a distance of 5,400 feet the main canal of the Anderson-Cottonwood Irrigation District interfered with the development of the highway.

Construction work in this area was held in abeyance until the irrigating season had closed and water drained from the canal. Then a new canal of 134-square-foot cross section was graded and lined with cement grout by means of guniting.

New Canal Built

The new canal was constructed approximately 90 feet west of the original canal which was then filled in and the highway roadbed constructed thereon.

To provide access to various ranches fronting on the new canal a paved road was constructed along its west bank and access to the southbound lanes provided at each end.

The cost of the project is approximately $785,000, exclusive of engineering, and the work was done under contract with Fredrickson and Watson Construction Company.

The existing highway temporarily carries northbound traffic, and under a contract awarded June, 1950, the grade of the lanes will be raised to conform to the grade of the southbound lanes, the same high type surface will be constructed, a parallel two-lane bridge 600 feet in length across Clear Creek will be built and an additional 4,000 feet of southbound lanes north of Clear Creek will be constructed linking this divided highway development with the existing portion south of Redding.

The road is a part of the main highway linking California with the Northwest and carries heavy traffic, both commercial and pleasure.

The development as a divided highway will enable it to serve the constantly increasing traffic with a greater degree of efficiency and safety.

An Experiment

Continued from page 27 . . .

The basic idea for the prefabricated panels is an adaptation of the prize-winning design prepared for the national Lincoln Welding Foundation Competition, by Claude H. Darby and George W. Smith of the Bridge Department.

K. B. Nicholas of Ontario, California, was the general contractor, and the steel panels were fabricated and erected by Bethlehem Pacific Coast Steel Corporation of Los Angeles, which also furnished the accompanying photographs.

The structure was designed and the contract was administered by the Bridge Department under the direction of F. W. Panhorst, Assistant State Highway Engineer—Bridges. The author was Resident Engineer.

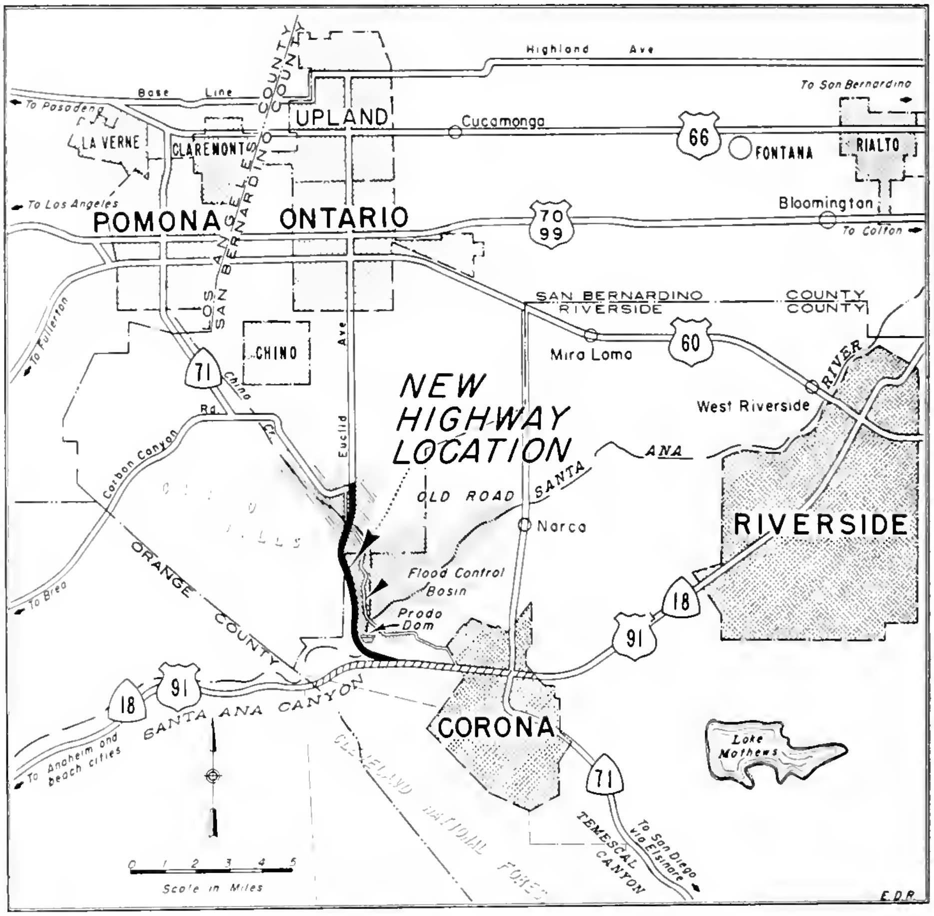
Prado Dam

A New Highway and Six Bridges Will Soon Be Open on Historical Route

If you drive along State Sign Route 71 in August, approaching Corona you will follow a winding roadway down into the bottomlands of the Prado Flood Control Basin. The road is narrow and you can't see very far around the curves. The crest of Prado Dam stands high above you.

But when you take the same trip next September, you will guide your car over the sweeping curves of a new Highway 71. You will feel the security of adequate width and a view of the road ahead. And as you glide around the west end of Prado Dam you will see that you are overlooking the crest of that great earthfill structure, and are high above the old road.

For September will bring the opening to traffic of a 6½-mile relocation project on Highway 71 in Riverside and San Bernardino Counties. The new route extends from Euclid Avenue at Pine Avenue to a junction with Highway 18-91 west of Corona.



Flood Waters Controlled

The story of Prado Dam is the story behind this highway relocation. For it was the construction of the dam that made it necessary to move the highway away from its present location in the bottom of the flood basin where the road is subject to inundation by even the smallest flood flows.

The dam retards the flood waters of the Santa Ana River so that they can never again bring staggering devastation to downstream Orange County. It is strictly a flood control structure and, as may be observed in the accompanying photographs, the basin contains no water during times of ordinary stream flow. The U. S. Corps of Engineers constructed Prado Dam and brought it to completion just prior to World War II.

Removal of the highway from the lowlands of the basin was not accomplished immediately after the dam completion due to the intervention of the war. After the conflict ended, planning for the project was resumed. Extensive negotiations with the Corps of Engineers were required in order to determine the government's share in the cost of the highway location. The final contract entered into by the Corps of Engineers, Riverside County, San Bernardino County, and the State provided that the United States would pay $650,000 toward the cost of the work. The remaining cost will be paid from state highway-user funds.

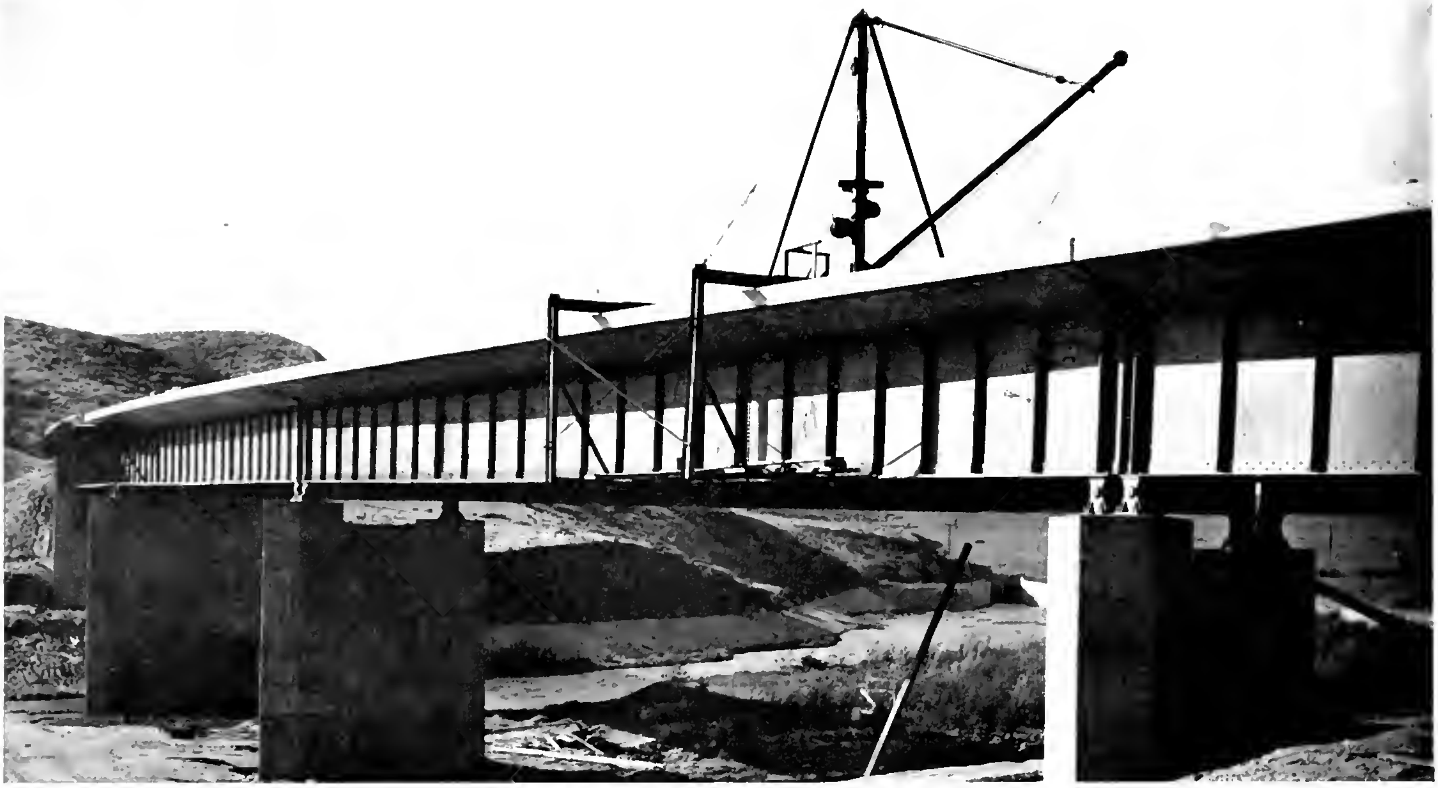
Early California Trail

Although Prado Dam will catch your eye as you drive the new road you will also be interested in reflecting that the general routing of the highway follows a trail whose origin is in early California history. For this was the way of the Colorado Road, a pioneer all-year route into California from the east.

This old trail connected Los Angeles with Fort Yuma on the Colorado River. It came north through Temescal Canyon past the site of the present city of Corona and after crossing the Santa Ana River ran along the base of the Chino Hills and up Chino Creek to Rancho Chino.

The Colorado Road gained national importance when the Butterfield Company's stages used it in hauling mail between St. Louis and San Francisco

Aerial view looking northerly along the relocation of State Sign Route 71 around Prado Dam and Flood Control Basin. The Santa Ana River Bridge is in the left foreground



This is the largest of six bridges being constructed in the relocation of Route 71. It is 495 feet long and crosses the Santa Ana River just below the outlet of Prado Dam. The structural steel girders and concrete deck have been finished and are ready for construction of the railing

from 1858 until the outbreak of the Civil War. On February 8, 1872, this pioneer trail first became part of a highway system when the Board of Supervisors of San Bernardino County declared the "Old Fort Yuma Road" to be a public highway. The present Riverside County was at that time a part of San Bernardino County.

Inland Route

In more recent times this highway has been traditionally known by generations of motorists as the "Inland Route" to San Diego. The project now nearing completion represents another step in its modernization, which has included 55 miles of new highway in San Diego County and southern Riverside County.

The current project provides a two-lane roadway with plant-mixed surfacing on traffic lanes and shoulders. The total roadbed width is 34 feet in the section of heavy cuts and fills and 38 feet in open terrain. Access to the highway is controlled. The major item on the roadway contract is roadway excavation, which totaled 806,000 cubic yards.

CONNECTING IMPROVEMENTS

As you travel south on Route 71 and pass through the interchange at the end of the new Prado Dam highway you will be entering another California thoroughfare whose traffic has outgrown roadway capacity. And you will be pleased to discover that something is being done about it.

As you drive along you will observe that operations have already started on the widening of Highway 18-71-91 between the Riverside-Orange County line and the eastern limits of the City of Corona. To help you identify this section of highway on the map it has been marked by hatching.

West of Corona a new two-lane roadway will be laid beside the present road to produce a four-lane divided expressway. Within the City of Corona, where the way is along Sixth Street, the plans call for widening to provide four traffic lanes and two parking lanes.

Peter Kiewit Sons Co., Arcadia, is the contractor for the westerly project and E. L. Yeager, Riverside, is the contractor for widening in Corona.

An outstanding feature of the project is the interchange with Highway 18-91. The design provides for full separation of all intersecting traffic movements and includes a four-span steel plate girder separation structure upon which Highway 71 crosses over Highway 18-91. There are three other major structures included in or adjoining the interchange. These are the overpasses of the Atchison, Topeka and Santa Fe Railway on both the main highway and the northwest ramp connecting the two highways, and a bridge to carry the ramp across Oakwing Creek.

Bridge Contracts

Two other bridges have been constructed—across the Santa Ana River and Chino Creek. The Santa Ana River structure is the largest on the project, being a five-span plate girder bridge 495 feet long. The three central spans measure 120 feet each.

The construction on Route 71 is being accomplished under two contracts. The contractor for the roadway work and for Chino Creek Bridge is A. Teichert and Son, Inc. of Sacramento.

It is estimated that final cost under the roadway contract will be approximately $640,000. The contractor's superintendent is Robert T. Skinner. Resident Engineer Kent B. Stone and Bridge Department Representative Samuel S. Dulberg are representing the State on this contract.

The bridge over the Santa Ana River and the four bridges in the interchange area are being built by R. M. Price Co. and O. B. Pierson of Altadena under a contract which will total approximately $480,000. Mr. Pierson is superintending the construction operations. Mr. W. H. Johnson is Resident Engineer for the State on the bridge contract.

An incidental feature of this highway project was the relocation of a section of the Texas-to-California 30-inch high-pressure gas line. An article in the January-February 1950 issue of *California Highways and Public Works* told the story of the Southern California Gas Company's operations in moving the big natural gas main in order to clear the way for the highway construction.

Hollywood

Continued from page 19 . . .

paver, a Blaw-Knox spreader, a Blaw-Knox tamping and finishing machine, and a Johnson float were used in the pavement operation. Water for the mixer was furnished from a 5,000-gallon water tank truck pulled by the mixer, this tank being supplied by another water tank truck hauling the water from city domestic supply on the job.

At the present time the paving of outer highways and cul-de-sac streets with asphaltic concrete and plant-mixed surfacing is under way and approximately 30 percent complete. Six-inch cement-treated base and asphalt concrete paving of off and on ramps will be under way shortly.

The estimated date of completion for this $1,358,000 contract is October 1, 1950, or approximately 60 days ahead of contract time.

HIGHWAY CONSTRUCTION COSTS INCREASE

By Richard H. Wilson, Assistant State Highway Engineer, Henry C. McCarty, Office Engineer, and Richard R. Norton, Assistant Office Engineer

This is the fourth in a series of articles on California Highway Construction Costs bringing the information up to date—Editor.

HIGHWAY CONSTRUCTION costs in California, as measured by the California Highway Construction Cost Index, appear to have entered the third major phase in the postwar period with an increase of 12.5 percent in the last three months.

The first phase was the period 1946 to mid 1948 when the index increased 30.5 percent from 166.1 (1940=100) to 216.8. The second phase occurred in the period from mid 1948 through the first quarter of 1950 when the index decreased 26.2 percent from 216.8 to 160.0. The third phase appears to have started in the second quarter of 1950 when the index increased 12.5 percent from 160.0 to 180.0.

Following is a listing of the index since the peak was reached in the first half of 1948:

Period	Index (1940 = 100)	Change from Previous Period	Change from Peak
1948 (1st half)	216.8		
1948 (2nd half)	216.4	−0.2%	−0.2%
1949 (1st qtr.)	200.4	−7.3%	−7.6%
1949 (2nd qtr.)	195.7	−2.3%	−9.7%
1949 (3rd qtr.)	187.9	−4.0%	−13.3%
1949 (4th qtr.)	178.8	−4.8%	−17.5%
1950 (1st qtr.)	160.0	−10.5%	−26.2%
1950 (2nd qtr.	180.0	+12.5%	−17.0%

The reversal of the downward trend in highway construction costs coincides with the same trend in general economic conditions throughout the country. Business activity is at an all-time high, with the construction industry in the forefront, showing an increase in volume of 45 percent for the first five months of 1950 compared to the same period in 1949.

This increase in construction activity has had an inflationary effect on material prices and wage rates. Lumber has risen sharply since the beginning of the year and there was an increase in the price of steel. There has been a general increase of $0.08 per hour for all construction labor in Southern California and an increase of $0.15 per hour for carpenters in the San Francisco Bay area.

The average number of bidders per project has dropped to 5.2 in June 1950, from a high of 10.8 in December 1949, and 6.5 in July 1949.

The war in Korea will undoubtedly have a further inflationary effect on prices and wage rates. The duration of this effect will depend on further world development.

No Parking

Continued from page 43 . . .

parking, show an average increase of about 3½ miles per hour. Congestion has been noticeably lessened by the availability of more lanes.

During 1949 the police department reported 57 accidents on the section involved. One-fourth of all accidents occurring between intersections were directly attributable to parking and others to the absence of a sufficient number of lanes. As this is written, the parking ban has been in effect only one month—too short a time for a reliable "before and after" study. It is encouraging, however, that during that month only one-half as many accidents occurred as during the same month last year.

Since 1941 most property contiguous to Mineral King Avenue has been zoned by the city planning commission as C—1½ (neighborhood commercial with off-street parking). Several new enterprises have gone into business and provided the required parking lots. As curb space was not at a premium, however, most of their customers continued to park at the curb.

. . . Continued on page 60

R. E. Ward Retires After 38 Years With the Division of Highways

After 38 years of continuous state service, R. E. "Ernie" Ward, Associate Highway Engineer, District II of the Division of Highways, retired on May 1, 1950. Numerous fellow employees attended a dinner at the Redding Golf and Country Club on the evening of April 27th to honor him and Mrs. Ward upon the occasion of his retirement.

Mr. Ward began his engineering career in 1908 on railroad surveys between San Diego and Yuma and later on irrigation surveys in the Imperial Valley. His first work on roads was for San Diego County in 1911, where he was associated with A. B. Fletcher, T. A. Bedford, R. S. Stalnaker and H. S. Comly, all familiar names in the Division of Highways.

On April 23, 1912, shortly after the California Highway Commission was organized, he went to work for the State as transitman on surveys for Highway 99 north of Redding in the vicinity of Pit River. H. S. Comly was chief of party and T. A. Bedford was district engineer. He became chief of party in 1914, and had a part in the location of many roads in District II.

Surveying in those days was a rugged business, particularly in the rugged mountains and canyons that comprise a good portion of District II. Teams and wagons were used if there was an existing road of any kind, but in many locations, such as the Trinity River, no roads existed and transportation was by foot or horseback, and supplies were hauled by pack train. A chief of party had considerable more to do than just survey; camps had to be established, cooks hired, food ordered and horses cared for. Ernie can tell many tales of the good old days.

In 1916 he was assigned as resident engineer in the first prison road camp in District II at Round Mountain west of Redding.

During the years from 1916 to 1942 he alternated as Chief of Party and resident engineer, locating and constructing many miles of highway in Northern California. In 1928 he was surveying in the rugged Feather River Canyon, and in 1934 he became resident engineer of a prison road camp established to construct a portion of the Feather River Highway.

R. E. Ward

From 1942 until his retirement this year he has held the post of right of way engineer for the District II right of way department.

Freeway Law

Continued from page 46 . . .

prohibiting left-hand turns or U turns, and schemes for handling traffic by systems of one-way streets, may not now be subject to attack on legal grounds.

It seems evident, also, that the language used by the Supreme Court in *People v. Ricciardi*, 23 Cal. (2d) 390, with respect to "direct access to the through traffic highway" is not construed by the district court to mean that an abutter's right of access extends, as has been contended, from his property directly across the street or highway, for the full width thereof. Access is satisfied if he may proceed from his property to one of the through traffic lanes of the highway.

Holloway v. Purcell and *Holman v. State of California*, one may be so bold as to predict, will stand as leading cases in the development of the highway law of California. The opinions in these cases take cognizance of existing conditions respecting traffic on our streets and highways and the efforts of the State to provide facilities that will be more nearly adequate for the expanding motor vehicle economy of California. They are a reassurance to the California Highway Commission and the Department of Public Works as they face the herculean task of the modernization of the California Highway System.

In Memoriam

RUTH K. DUNN

Ruth K. Dunn, a member of the Maintenance Department in the District VII Division of Highways organization, passed away May 21, 1950, at the Queen of the Angels Hospital in Los Angeles.

Mrs. Dunn first entered state service in 1929 and was an employee of the Maintenance Department in Los Angeles since 1931. The position she held at the time of her death was that of Supervising Clerk, she being in charge of the stenographic staff of the Maintenance Department and also acting as secretary to the District Maintenance Engineer.

Mrs. Dunn was very devoted to her work and although she had been in ill health for quite some time she reported daily to her office and carried on the duties of the position up to within two weeks of her death. She was an outstanding employee. She had an enthusiastic and sincere loyalty for the State Division of Highways organization and particularly for her own department, the District VII Maintenance Department. The high morale of this unit was due in no small part to her.

She was an active member of the Barbara Stanwick Chapter of Athena Sorority and her hobby was her garden as she derived much pleasure from beautiful flowers.

Mrs. Dunn's many friends in the Division of Highways and throughout the State deeply regret her passing.

State Fair

Continued from page 24 . . .

standards of the three sections which make up this 10 miles is scheduled for this year. It enters the city over the Tower Bridge across the Sacramento River.

North Sacramento Freeway

U. S. 44-99W from the east and north enters Sacramento by way of the North Sacramento Freeway, one of California's most modern highway developments of the freeway type, with all cross-traffic eliminated from the divided roadways by means of grade separation structures. This route enters the city proper over the 16th Street Bridge across the American River.

The other seven routes are all two- or three-lane highways in their approach to the city.

Of greatest present interest in state highway development at Sacramento is the proposed relocation of State Route 98 with a crossing of the American River near Elvas Junction. As the first tangible step in advancing this proposed relocation, the State will award a contract this year for construction of the substructure for the new bridge at Elvas Junction. At the same time an intensified program for right of way acquisition for the proposed route is being pursued by the State.

As the Division of Highways, Department of Public Works, carries out plans to expand highway facilities serving Sacramento, the fair has perfected its own plans of staging its greatest exposition to date.

Features of Fair

There will be magnificent night entertainment spectacles, with a dazzling ice revue to be presented the first five nights; stars of stage, screen and radio will appear on subsequent nights. There will be the thrilling Sunday motorboat races on the newly-constructed fair grounds race course, the swank horse show, the beautiful flower show, the important art show, the brilliant Pageant of California Fashions, the great livestock shows, the dynamic county and foreign exhibits, the International Wine Show, hobby and food shows, a dairy show, the splendid horse racing program, the manifold exhibits of the women folk and great displays of farm machinery and household articles of infinite variety.

One of the most interesting and unique new events to be staged at the fair will be the truck rodeo. Drivers of massive trucks, with trailers attached, will demonstrate their skill in manipulating their huge machines through a road maze of tight corners and other difficult situations. The truck rodeo, one of the many free attractions provided by the fair, will be held on the parade grounds on the eastern side of the 207-acre fair site.

General admission to the fair remains the same low 50 cents, including tax, with children under 12 admitted free.

For 11 glorious days and nights the State Fair will show California on parade, with a multitude of exhibits reflecting the ever-expanding economy of a mighty commonwealth, which is a leader in agriculture, industry and trade.

Ira G. Thomas Retires To Enjoy Rest

After almost 33 years of state service, Ira G. Thomas retired on July 19, 1950.

Mr. Thomas went to work for the Division of Highways in District V in San Luis Obispo on November 1, 1917. From District V, where he worked up to the position of District Office Engineer, he went to District I at Willits and Eureka as District Office Engineer. He moved to San Diego as District Office Engineer when District XI was organized in 1933. In 1935 he was transferred to Sacramento as Assistant Engineer in the Department of City and Cooperative Projects where he served for the last 15 years.

Born in Iola, Kansas, July 19, 1889. Mr. Thomas went to South Pasadena, California, in 1903 and graduated from South Pasadena High School in 1909. He attended the University of Southern California for one year and then entered the University of California at Berkeley, graduating with B.S. in Civil Engineering in 1914. He was married to Bessie E. Dashiell of Berkeley September 5, 1914. The couple has two daughters, Betty Lou and Merle Ellen, both of whom are married.

After graduation, Mr. Thomas was employed by the Los Angeles County Road Department as draftsman and Resident Engineer until July, 1917, when he became a bridge designer for Ventura County, accepting in the same year a position with the California Highway Commission.

Ira G. Thomas

Mr. and Mrs. Thomas plan an extensive trip encircling the United States, going up the Redwood Highway to Washington, thence east along the northern border with diversions to Lake Louise and Banff and Winnipeg in Canada, thence to Duluth circling around the southern edges of the Great Lakes through Chicago, Detroit, on down the Saint Lawrence to Nova Scotia, south along the eastern seaboard to Florida. While in the south they will take the Caribbean cruise then return to California by the southern route to Los Angeles and back to Sacramento.

A Treatise

Continued from page 13 . . .

finished during the fall of 1948 and received a light bituminous penetration treatment, a few small pot holes had developed and a small amount of raveling had taken place, mostly along the centerline, but in general, the surface was in good condition.

An inspection trip made in February, 1950, showed no significant change from last year and all 11 sections were in good condition with the exception of some light surface raveling referred to above.

For a comparison, areas of untreated bases, located adjacent to the treated sections, which were in good or satisfactory condition during the fall of 1948, failed during the following winter. *See Figure 10.*

Lime stabilization treatment when compared with low cement treatment for bases or subbases, permits greater flexibility during construction as it is not essential that the lime-treated material be compacted soon after mixing. In areas where comparatively inexpensive agricultural lime may be obtained in bulk, a considerable saving may be possible as against other comparable types of treatment. On the basis of the above cost analysis and provided cheap lime were available this saving would amount to approximately $1,300 per mile for a base course 6 inches thick and 20 feet wide.

The work described in this report was initiated by District Engineer C. H. Whitmore of District III with headquarters in Marysville, California, and was carried out under the direction of Maintenance Superintendents T. T. Buell at Truckee and E. Willis at Placerville with C. H. Weeks in direct charge of the Georgetown job.

All tests were performed in the laboratory of the Division of Highways under the direction of T. E. Stanton, Materials and Research Engineer, and F. N. Hveem, Staff Engineer of the Materials and Research Department.

TABLE V

TEST RESULTS OF FIELD SAMPLES

III-ED-93-B

Date sampled	O.M. test No.	Aggr. test No.	Treatment	Sampled		Test results								
				From	By	Grading % Pass ¾	#4	200	5u	1u	PI	R Val	Density weight cu. ft.	Remarks
Nov., 1948	U 612	48-5200		Lime from truck	Zube			14						45% Moisture
	U 613	5201	Untreated	Roadbed-Sec. 11	Zube	91	57	27	9	5	7	79	136	Same location
	U 614	5202	Lime added	Roadbed-Sec. 11	Zube	84	31	12	2	1	1	87	135	
	U 615	5203	Untreated	Roadbed-Sec. 11	Zube	80	51	26	10	5	16	71	137	Same location. Only few loads of this material placed
	U 616	5204	Lime added	Roadbed-Sec. 11	Zube	75	44	18	4	2	11	79	136	
	U 617	5205	Untreated	Roadbed-Sec. 11	Zube	91	60	28	10	5	7	77	134	Same location
	U 618	5206	Lime added	Roadbed-Sec. 11	Zube	91	61	24	5	2	5	82	131	
	U 619		Lime added	Roadbed-Sec. 6	Zube	78	52	20	4	2	NP	85	125	
April, 1949	U 1046	49-2415	Lime treated	Roadbed-Sec. 2	Zube						NP	81		
	1047	2416	Lime treated	Roadbed-Sec. 5	Zube						NP	91		
	1048	2417	Lime treated	Roadbed-Sec. 6	Zube						NP	82		
	1049	2418	Lime treated	Roadbed-Sec. 11	Zube						NP	86		

Richard H. Wilson on A. S. C. E. Committee

Richard H. Wilson, Assistant State Highway Engineer in charge of Administration, has been appointed as a member of the Committee on Developments in Highway Engineering and Construction of the American Society of Civil Engineers.

From the point of view of the engineer practicing in the highway field, this national committee on developments in highway activities is one of the most important of the standing committees of the American Society of Civil Engineers. The appointment of Mr. Wilson to this nine-man committee, which is nation-wide in its scope, is a signal recognition of the preeminent position held by the California Division of Highways and its engineering staff in highway affairs.

The function of this committee is to keep the membership of the American Society of Civil Engineers informed of developments on all phases in highway engineering, economics, and construction and to point out gaps in highway science that should be filled. A further function, when such a discrepancy is uncovered, is to draft recommendations for action to be taken.

Members of this committee are appointed for three-year terms; the Chairman is Mr. A. N. Carter, Manager of the Highway Division of the Associated General Contractors of America, and the Secretary is Mr. Joseph Barnett of the Bureau of Public Roads.

Of the nine members, Mr. Wilson is the only representative from the West.

Another Loss

ontinued from page 16 . . .

ears have seen the development of eavily traveled freeways in the metro-olitan portion of District VIII.

Building Freeways

"In this portion of District VIII, we ave been busy during the past several ears converting old main routes into reeways, and constructing new free-ays. There are a number of freeway rojects now under contract. These reeways now total approximately 90 iles in District VIII. Plans for ap-roximately 30 additional miles of free-ay are nearing completion.

"The principal mountain recrea-onal area of Southern California is in istrict VIII. The mountains are ex-remely rugged and wooded in the igh elevations. The famous resorts of ig Bear Lake and Lake Arrowhead re in this recreational area.

"During the earlier years of District III we constructed a high standard ountain road via Waterman Canyon to this recreational area. Since the oot of the grade is only 60 miles from e center of the City of Los Angeles, is road had long had overwhelming affic. To relieve this condition, a new, uch higher standard mountain road being constructed into this mountain rea via City Creek. It is all completed, r under contract.

Desert Roads Specialty

"My professional specialty has been e development of desert highways urfaced with light bituminous pave-ents and a full 27-year study of the ovement of wind-borne sand and ust as it affects highways and drainage reas. As the years have gone by vari-us papers I have written for maga-ines and engineering journals have esulted in extensive correspondence ith engineers of foreign countries on e subject of the movement of wind-orne sand and dust.

"In conclusion, I have enjoyed my ork with the State enormously. We ave had a series of wonderful Chief ngineers. They have all been splendid aders: A. B. Fletcher, R. M. Morton, harles H. Purcell, and George T. IcCoy. They have all seemed to me to be dear personal friends. It is a true sign of leadership for the superior officer to appear in this light to the subordinate. I have had several offers to leave the state service at greatly increased compensation, but have never been really tempted to do so. I am extremely happy that I have stayed with the State during all the years.

Praise for Stanton

"In listing Chief Engineers, Mr. T. E. Stanton should, in my opinion, be listed between Mr. Fletcher and Mr. Morton as one of our truly great chiefs. During the latter part of the administration of Chief Engineer Fletcher, Tom Stanton, now Materials and Research Engineer, was in fact "Acting" Chief Engineer. Mr. Fletcher's duties had been extended to include other fields and Mr. Stanton had taken over much of the highway administrative responsibility of Mr. Fletcher.

"I have never felt that Mr. Stanton received proper credit for his fine handling of these duties during a period when the department was under extreme criticism. Mr. Stanton continued as Assistant State Highway Engineer for a time under Mr. Morton and then took over the duties of Materials and Research Engineer. He organized the very wonderful laboratory that is recognized throughout the entire Nation as second to none. His department has made possible the standardizing of specifications and much of the universal high quality of construction is due to the Materials and Research Laboratory.

"When I was considered for district engineer, I was instructed to report to Mr. Stanton in Sacramento (though Mr. Morton had already been appointed chief engineer and actually promoted me to district engineer). I recall that Mr. Stanton thoroughly questioned me, and it is my feeling that his recommendation to Mr. Morton had great weight in my promotion to District Engineer for District VIII. During the time Mr. Stanton was in fact administrative "acting" head of the Division of Highways, he introduced reforms in the engineering organization throughout the State that have been of inestimateable value to California in raising the quality of work. These reforms included the protecting of the civil service status of employees and laying the groundwork in extending the merit system in the Division of Highways.

"Upon retirement, I will open a consulting office in San Bernardino at 107 East Highland Avenue, but will not do this until I have had a few months rest. I expect to spend the remainder of my life in San Bernardino, though I have a home also at Balboa where I will spend week ends and vacations.

"I belong to the following organizations: Member, American Society of Civil Engineers; member, American Association of Engineers; Rotary Club."

High Praise

E. Q. Sullivan, State Highway Engineer with headquarters in San Bernardino, who is finishing his distinguished 36-year career with the State Division of Highways this coming August, is well known in the Pomona area. Ever since 1923 he has been the Chief Engineer of District 8, which embraces San Bernardino County and the western portion of Riverside County. During this period of time he has supervised highway work costing an estimated $75,000,000.

Sullivan's retirement follows closely that of S. V. Cortelyou, who was Chief Engineer of the Los Angeles Division, District VII of the State Highway System. Both men are not only high type engineers but men of sterling qualities of character. Their reputation is nationwide. No better highway engineers are to be found in the United States than Cortelyou and Sullivan, and their retirement means a great loss to the State.

The roads that these men have built are lasting monuments to their ability and their knowledge of the needs of the areas which these roads serve.

The Progress-Bulletin, Pomona

IT'S UP TO YOU

California's modernized highways are being engineered for safety, but safe driving remains the responsibility of the individual motorist. When you drive the new highways, keep alert and keep speed under control at all times.

Grading Chalk Hill—1913 methods

El Camino Real

Continued from page 29 . . .

with an espalier of outside plumbing on the side, but otherwise as it was in its heyday as shown in the accompanying photograph taken in 1887, furnished through the courtesy of Mr. Sam Hayes, one of the present owners.

Pioneer Landmark

This old landmark is still in the ownership of the heirs of Cecil Haig, the scion of a prominent London cotton broker who acquired the property along with a sizeable cattle ranch, just as the completion of the coast line of the Southern Pacific in 1886 caused the discontinuance of the slower and less comfortable but more picturesque stages.

By this time the large Spanish grants, with their vague boundaries, had passed from the hands of the grantees. The vast areas of grazing land were divided into grain ranches.

The coastal valley between the mountains and the ocean from Ventura to Hueneme was given over to raising grain. Previous to the advent of the railroad the grain from this valley was hauled to Hueneme and shipped from there by boat.

The valley land from the Conejo grade to Cahuenga Pass, at Hollywood, was devoted to the same type of farming. Los Angeles provided the market and delivery was made by eight- and 10-horse teams pulling two large wagons in tandem.

Horse and Buggy Road

It was as a county road serving these ranches in the horse and buggy days that this road, now known as Ventura Boulevard, passed into the control of the California Highway Commission as State Route 2.

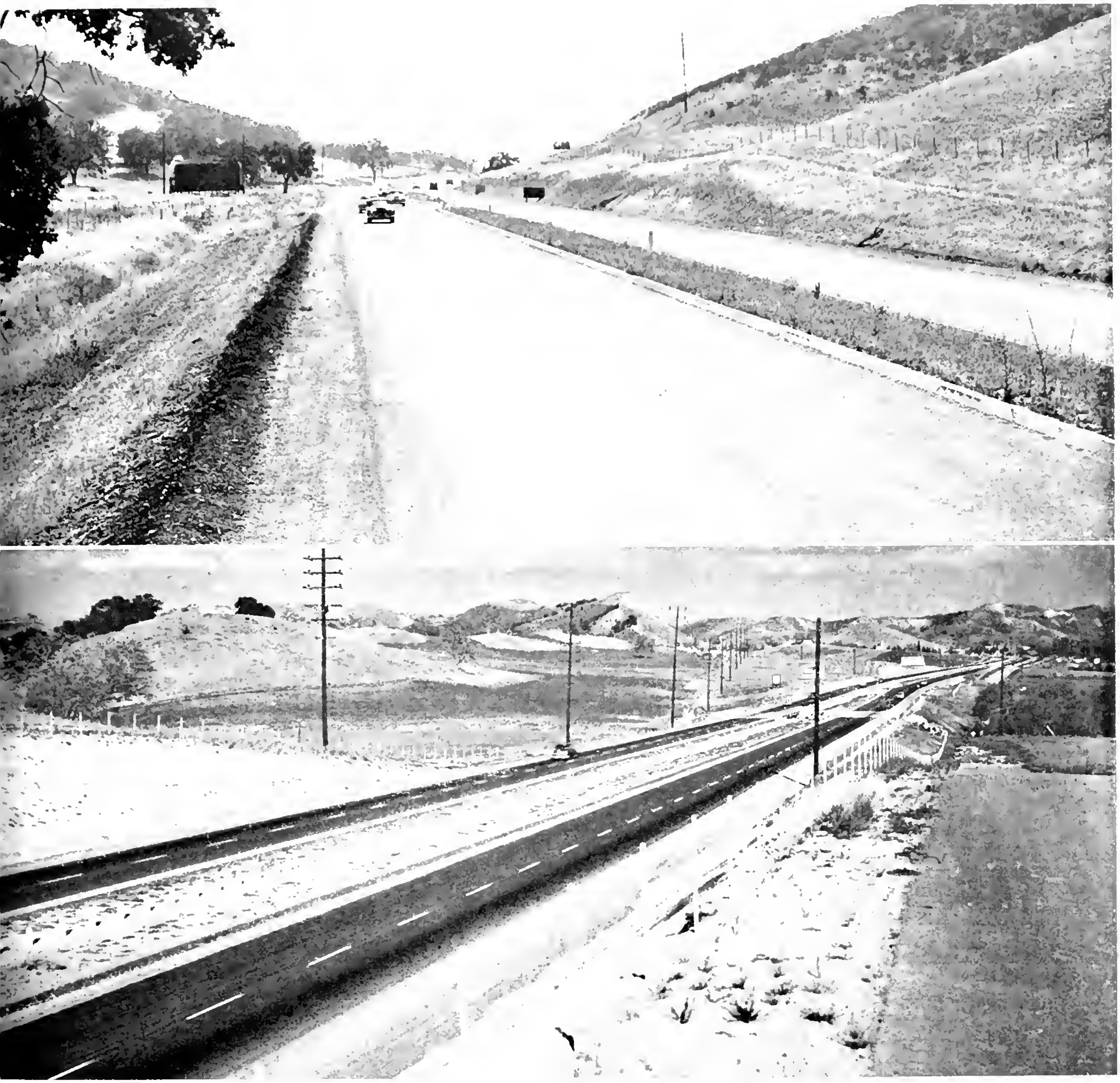
Construction of the highway commenced in December 1912 at Ventura and Lankershim Boulevards, proceeding through the grain fields of the Lankershim ranch for seven and a half miles. As shown by the accompanying photograph taken during paving operations near what is now Studio City, the San Fernando Valley at this time was very sparsely settled. In fact, aside from the wheat fields of the Lankershim and Van Nuys ranches and a few apricot and peach orchards at Owensmouth (Reseda), Lankershim (North Hollywood) and Van Nuys, the area between Ventura Boulevard and San Fernando Road, was covered with chaparral.

The old adobe landmark at Encino was at that time the headquarters of an active ranch, grazing large flocks of sheep over the Hollywood hills.

This contrast was followed by the construction of the Chalk Hill Grade, whose meanderings are still visible, and in rapid succession subsequent contracts extended the 15-foot width of four-inch thickness concrete pavement from Calabasas over the Conejo Grade through El Rio to Ventura. This two-lane pavement was completed from Cahuenga Pass to Ventura by 1917.

Progressive Improvement

At various times during succeeding years this stretch of roadway was improved by realignment and resurfacing to provide, generally, a 20-foot concrete pavement.



UPPER—Completed Spicer contract post Calabasas. LOWER—Completed Kiewit contract, looking south from Media Creek toward Agoura

As Ventura Boulevard northerly :om the present end of the Holly- :ood Freeway at Vineland Street in North Hollywood to Calabasas, is now Los Angeles City street, the recon- :ruction and maintenance of this sec- on of the highway is under the juris- iction of the City of Los Angeles.

The first step in the evolution of this oad from a two-lane roadway to a our-lane divided highway with lim- ed access, was the completion in October 1948 of a one and one-half mile section extending northerly from the city limits of Los Angeles at Calabasas.

In August 1949, Peter Kiewit Sons' Company finished 3.2 miles of similar type construction, completely by-passing the community of Agoura. While the old pavement through Agoura, with its many sharp curves and rolling grade, was the source of much delay and annoyance to through traffic, it remains as an adequate service road for the village. Convenient access to the new highway is provided at three locations.

Filling in Gap

Filling in the gap between the two completed sections mentioned above, rapid progress is being made on four and one-half miles under contract to Basich Bros. Construction Company and Basich Bros. of Los Angeles. On the southerly third of this section the

Near Calabasas, showing heavy grading operations in progress, with public traffic passing through construction

existing right of way is included to some extent in the realignment but the northerly two-thirds is almost entirely separated from the present roadway.

These three contracts are of a similar deisgn calling for heavy grading and long haul of excavated material from cut to fill. The pavement consists of two roadways, each paved with a 29-foot width of plant-mix surfacing supported by an 8-inch blanket of untreated rock base over a variable thickness of subbase and lined with a five-foot bituminous-treated shoulder.

With the exception of plant-mix surfacing on the Spicer contract, the subbase material, untreated rock base and paving aggregates for these three contracts have been or will be secured from local sources and crushed, screened and blended by the contractor's equipment. It is expected that in the near future bids will be received for the further extension of divided highway 6.6 miles through Thousand Oaks almost to Newbury Park.

During the 38 years since this road became a part of the State Highway System great changes have occurred in the Conejo Valley. Under the trees at Thousand Oaks (then the Crowley Ranch) where the brood mares and their frisky young offspring made a picture of complete contentment, elephants and their progeny now portray absolute indifference and resignation.

The mental attitudes of the lions, leopards, tigers and other occupants of the "Wild Animal Compound" now located under these same trees, are a matter of conjecture. The trim well-kept homes and gardens in this valley give the impression that here live people who have found a haven of peace and well being.

No Parking

Continued from page 53 . . .

Newer applicants, seeing the slight usage being made of such lots, have invariably protested the requirement and it has been difficult for the planning commission to get the amount of off-street parking they knew some day would be needed without antagonizing applicants. The all-inclusive parking ban will now cause each owner of a new business to be as interested as the planning commission in providing sufficient space for his future customers.

Chief of Police F. D. Bentzen and other officials mention other incidental improvements in driving conditions they have already noticed. Cross traffic at unsignalized intersections is moving across with less delay than formerly when large trucks, parked adjacent to the intersections, restricted visibility. In the past, school children on bicycles and scooters were forced to swerve out from the curb into the lane of travel when reaching each group of parked cars. The danger of them being struck by overtaking vehicles was always present, and a few accidents of this type have occurred. Now the children follow a reasonably straight path close against the curb. Drivers entering the highway on a right turn now move out much more rapidly and confidently into the curb lanes. In the past such drivers often were forced to wait long periods for a safe gap in the line of vehicles using the one lane. Since the one former lane in each direction was 15 feet wide, many drivers made left turns from the right portion of the lane. Proper left turns from the inner lane have already largely superseded the previous hazardous maneuvers. Mothers mention a new sense of relief from the fear that their children might step out from between parked cars.

Thus the farsighted officials of Visalia, while recognizing that State Highway Route 10 must soon be widened and otherwise improved by application of modern highway design principals, have acted wisely and boldly to relieve congestion, delay and hazard, until funds are available for a major improvement, by prohibiting parking along almost the entire length of that route through the city. The change has achieved a marked success. It has greatly reduced congestion and delay, has speeded up traffic flow but not to a dangerous extent, and gives clear promise of causing a substantial decrease in accidents.

EARL WARREN
Governor of California

•

CHARLES H. PURCELL
Director of Public Works

•

FRANK B. DURKEE
Deputy Director

•

HIGHWAY COMMISSION

H. PURCELL . . . . Chairman
RRISON R. BAKER . . . . Pasadena
MER P. BROWN . . . . Placerville
MES A. GUTHRIE . . . . . . San Bernardino
WALTER SANDELIN . . . . Ukiah
ESTER H. WARLOW . . . . Fresno
ARLES T. LEIGH . . . . San Diego

DIVISION OF HIGHWAYS

). T. McCOY . . . . . State Highway Engineer
ED J. GRUMM . . Deputy State Highway Engineer
G. STANDLEY . . Assistant State Highway Engineer
M. GILLIS . . . Assistant State Highway Engineer
W. PANHORST . . Assistant State Highway Engineer
W. VICKREY . . Assistant State Highway Engineer
I. WILSON . . . Assistant State Highway Engineer
E. STANTON . . . Materials and Research Engineer
ORGE F. HELLESOE . . . . Maintenance Engineer
E. WAITE . . . . Engineer of Design
RL WITHYCOMBE . . . . Construction Engineer
B. LA FORGE . Engineer of Federal Secondary Roads
. CAMPBELL . Engineer of City and Cooperative Projects
RL E. SORENSON . . . . . Equipment Engineer
. McCARTY . . . . Office Engineer
. YOUNG . . . . Traffic Engineer
. WOMACK . . . . Planning Engineer
). JAHLSTROM . . . . Principal Bridge Engineer
WART MITCHELL . . . Principal Bridge Engineer
. HIGGINS . . . . Comptroller

Right of Way Department

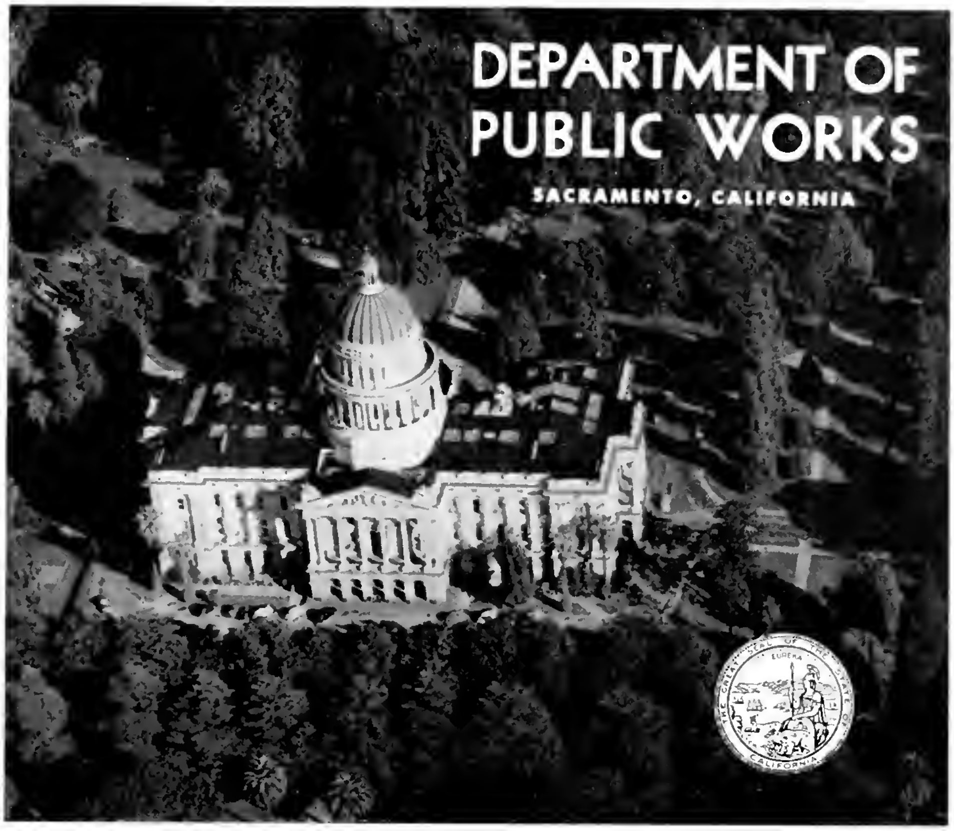
NK C. BALFOUR . . . Chief Right of Way Agent
. WAGNER . . . Deputy Chief Right of Way Agent
ORGE S. PINGRY . . . . Assistant Chief
. J. PIANEZZI . . . . Assistant Chief
I. MacDONALD . . . . Assistant Chief

District IV

. H. SKEGGS . . Assistant State Highway Engineer

District VII

). HARDING . . Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
E. Q. SULLIVAN . . . District VIII, San Bernardino
S. W. LOWDEN . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. R. SIMPSON
Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
W. K. DANIELS . Assistant State Architect (Administrative)
P. T. POAGE Assistant State Architect (Design and Planning)
D. C. WILLETT . . . . Chief Construction Engineer

Headquarters

A. F. DUDMAN . . . Principal Architectural Designer
C. L. IVERSON . Supervising Architectural Draftsman
CARLETON PIERSON . Supervising Specification Writer
FRANK A. JOHNSON . . Principal Structural Engineer
C. A. HENDERLONG
Principal Mechanical and Electrical Engineer
WADE HALSTEAD . . . . . Supervising Estimator

Schools

W. H. PETERSEN Principal Structural Engineer, Sacramento
H. W. BOLIN . Principal Structural Engineer, Los Angeles

nted in CALIFORNIA STATE PRINTING OFFICE 27899 7-50 25 400

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA
RETURN POSTAGE GUARANTEED

SEC. 34.66 P. L.
U. S. POSTAG
PAID
Sacramento, C
Permit No. 15

Seattle Public Library,
Seattle,
Wash.

CALIFORNIA STATE HIGHWAY SYSTE

SCALE IN MILES

0 50 100

California

SEPTEMBER . 9 . 1850

SEPTEMBER 9 195

Centennial Edition

EARL WARREN
Governor of California

CALIFORNIA'S tremendous progress in the century that has elapsed since its admission to the Union has been due in large part to the steady development of its highway system.

The trails followed by the gold seekers of 1849 soon became stagecoach routes and the necessity for year-around travel brought about the building of roads. With the advent of the automobile came large-scale road construction, and our highways have been steadily improved until we now have one of the finest highway systems in the Nation. We have become literally a state on wheels—a state with more motor vehicles than any other state. We have a million and a half more vehicles than we had 10 years ago.

We have been hard pressed to keep up with the demands for new and improved highways. To meet these demands we are now spending nearly $100,000,000 per year on our highway program. We must continue to spend this much or more for many years to come, to keep in step with our growing population and our expanding transportation needs.

In view of the importance which highways have assumed in our economy, it is most appropriate that *California Highways and Public Works* should record in this centennial issue the progress that has been made in highway development during the past 100 years. It is a story unequaled in construction history.

Earl Warren

From Trails to Freeways

THIS, BRIEFLY, is the story of 100 years of highway building in California, with prefatory chapters going back to the days of Father Junipero Serra, Don Gaspar de Portola, Don Pedro Fages and Juan Bautista de Anza. These explorers and the pathfinders who came after them hewed trails through the wilderness that, with few deviations, are the major state highway routes of today.

To tell the complete history of the development of California's world-famous system of highways would require volumes. These pages perforce must touch only upon the highlights of that history.

On the one hundredth anniversary of the admission of our State to the Union, this centennial edition of *California Highways and Public Works* is dedicated by Director of Public Works C. H. Purcell, State Highway Engineer George T. McCoy and the California Highway Commission to the people of California, both living and dead, who through their bond issues and their contributions to the Highway Users Fund have made possible, with the aid of their elected representatives in the Legislature, who enacted necessary enabling laws, the far-flung, splendid State Highway System acclaimed by road builders the world over.

California Highways and Public Works is indebted to the authors of the written words which follow, to Van der Goes, Bridge Department, Division of Highways, creator of the cover page and the double-page illustration inside, to Miss Caroline Wenzel, California Section, State Library, to Bancroft Library, to Stanford University Press, to Carroll D. Hall, Curator, Sutter's Fort, and to many others who have helped to compile the story herewith presented.

KENNETH C. ADAMS, *Editor*

Deputy Director

FRANK B. DURKEE

Director Public Works

CHARLES H. PURCELL

State Highway Engineer

GEORGE T. McCOY

CALIFORNIA HIGHWAY COMMISSION

HARRISON R. BAKER

HOMER P. BROWN

JAMES A. GUTHRIE

CHARLES T. LEIGH

F. WALTER SANDELIN

CHESTER H. WARLOW

JUNIPERO SERRA
1713-1784
California's first and greatest pioneer; founder of the Mission Chain—California's first highway. (From the original portrait, painted in Mexico in 1773.)
Courtesy, University of California

Foreword

In the chapters written by Alice Fisher Simpson and Stewart Mitchell is unfolded the story of California's first famous Emigrant Trails and the people who blazed them: The trails of the early explorers in the service of His Majesty, the King of Spain; the immortal Padres, intent on planting the cross of Christendom among the heathen children of the wilderness; the fur traders and the mountain men, restless and adventurous; the white-covered wagons of the emigrant trains, answering the call of "Gold!" It is the colorful epic of stagecoach days, when the sturdy Concords, rocking and swaying, rumbled over the narrow, twisting roads of the '60's and '70's; the mule-teams and the cumbersome freighters—whose glory was dimmed by the coming of the "Iron Horse."

Today, many of these famous old trails have become important U. S. and state highways, over which the motorist may travel with ease and comfort—basking in the romance of yesterday, and reliving the dynamic events of California's glorious past.—*Editor*.

Chapter I

Historic Trails of the Padres

By Alice Fisher Simpson

In the year 1769, from Loreto in distant Baja California, that long, narrow peninsula bordered by the Pacific Ocean and the Gulf of California, began the long arduous trail that was ultimately to become California's first highway. In that year came Father Junipero Serra and Governor Don Gaspar de Portola, to plant the Cross of Christendom and the Royal Standard of Spain in the wilderness of Alta California.

On Vizcaino's exploration of the California Coast in 1602, Father Ascension, recorder for the expedition, had sent much valuable data back to Spain, regarding the possibilities for colonizing the region as well as the natural resources to be found there.

The Spanish Government had long contemplated making permanent settlements in the northern region, and was now spurred into action by the encroachments of the English and the Russians. The plan of the Spanish Crown coincided perfectly with that of the zealous Junipero Serra, President of the Lower California Missions, whose cherished ambition had long been the spiritual conquest of Alta California, and the establishment of a vast chain of Franciscan stations.

In 1768, at a conference between Junipero and Jose de Galvez, the visitador-general, the plans of the King were discussed, together with the means of carrying them out. It was agreed that San Diego should be the initial point of the proposed new settlements. Two different expeditions were to be dispatched to that point, one by land and the other by sea. Whichever would arrive at San

Diego first was to wait there for a period of 20 days for the other. In the event that the second did not arrive by that time, the other was to proceed to Monterey.

Three ships were to be employed in the sea expedition, each sailing at a subsequent time. The land expedition was also to be divided into two parts, with each unit marching separately. The vessels sailing from La Paz, were to carry a portion of the troops, the camp equipage, church ornaments, agricultural implements and provisions. The land parties were to be made up of the remainder of the troops, the colonists and Indian servants. From Loreto they would drive before them their herds and flocks, with which the new colonies were to be stocked. Four missionaries were to accompany the sea party, while two, including Father Serra, would travel with the second land expedition, with the Governor, Don Gaspar de Portola, in command.

After making all arrangements for the care of the Lower California Missions, placing them in the hands of his old friend, Francisco Palou, Serra intended leaving with Portola and his men when they marched from Loreto on March 9, 1769, but with the excessive travel and activity, the ulcerated leg from which he had long suffered had become so aggravated and swollen that he was forced to remain behind, joining them later on May 13th at the frontier. Seeing the condition of his leg, Father Palou implored Junipero to remain at ease in Lower California and allow him to go to San Diego instead. But the wiry little priest was determined to carry out the grand conquest he had so long contemplated. "I have placed my faith in God," he answered, "and trust in His goodness to plant the standard of the Holy Cross not only at San Diego, but even as far north as Monterey."

The trip was rough and tedious. On the way the Padre's ulcerated leg became even worse; it was dreadfully inflamed and the pain was intense. He was no longer able to ride his mule, so Portola ordered the construction of a litter, upon which he might be carried in a prone position by the Indian neophytes. But Serra flatly refused, on the grounds that the poor wretches already had enough to bear. Instead, he summoned one of the muleteers and asked him if he knew any remedy for the angry ulcer that had caused him so much suffering.

"Why, Father, I am no surgeon," the bewildered man replied. "I am only a muleteer! * * * I cure only the sores on the backs of the beasts."

To this the determined Serra responded: "Then treat this ulcer the same as though it were a sore on the back of one of your mules."

While the amazed company watched, the muleteer went to work. He took a small lump of tallow, mashed it between stones, mixed it with certain herbs which he found growing nearby, and heated the whole. Then he applied the compound to the ulcerated leg and bound it on. Its soothing effect enabled the Padre to get his first night's sleep in several days. The next morning he was able to pursue his journey in comfort.

From here on travel was slow and difficult. Several of the Indians died from fatigue; some had to be carried on litters, while others deserted. But encouraged by the undying faith of Father Serra, the expedition kept going. After a spirit-killing journey of nearly two months, the wayfarers came in sight of San Diego on July 1, 1769. As they looked down upon the bay, they beheld the two ships of the expedition, the 200-ton *San Carlos* and the *San Antonio* riding at anchor. The third vessel, the *San Jose,* carrying among other items, 10,000 pounds of dried meat and a quantity of dried beans, raisins and dried fish, had as yet not been heard from.

Serra and Portola were overjoyed as they beheld the tents dotting the shore line, proclaiming the arrival of Rivera y Moncada and the first part of the land expedition. As they hastened on to meet their comrades, Portola's soldiers fired volley after volley. Moncada's troops instantly returned the salvos; and then, as if suddenly awakened into life, the ships riding at anchor joined in celebrating the glad reunion.

Although the *San Carlos* had been the first vessel to sail, leaving La Paz on January 9, 1769, she arrived 20 days after the *San Antonio,* which sailed February 15th. The vessel had been driven off her course by storms, and her passengers endured untold suffering. Of her crew all but one sailor and the cook had succumbed to scurvy. Many of the soldiers had died.

It had been planned that those who were to proceed to Monterey would travel by sea aboard the *San Carlos*, as the *San Antonio* was to be sent back to San Blas for provisions. When it came time, there were not enough sailors to man the vessel, so it was agreed that the party would march overland. Accordingly, on July 14th, with transport animals, baggage and provisions, the expedition started in search of the Bay of

Mural by Albert Herter. Reproduced by courtesy of Los Angeles Public Library

Monterey, so glowingly described by Vizcaino. Personnel consisted of 64 persons: Governor Portola, Fathers Crespi and Gomez, Captain Rivera y Moncada, Lieutenant Fages, Engineer Costanso, Sergeant Jose Ortega and a number of soldiers, muleteers and Indian servants.

No sooner had Portola and his men departed than the enthusiastic Serra turned his attention to the founding of the mission. July 16th was the date decided upon. It was appropriate, since it was on this day in the year 1212 that a great victory had been won by the Christians over the Moors. The spot selected was on the north side of the bay. Here a great cross was erected, and with the celebration of Holy Mass, Junipero Serra had established the first settlement in Alta California—the Mission San Diego de Alcala.

At first, the Indians appeared friendly, and willingly accepted any gifts they were offered; but as time went on, they became most troublesome. On August 15th, armed with bows, arrows, wooden scimitars and war clubs, they broke into the mission in great numbers to pillage and loot.

To complicate matters, the rainy season came on. Supplies were running dangerously low; the entire colony was faced with famine unless the *San Antonio* returned soon from San Blas with provisions. In the midst of the confusion, the exhausted Portola and his weary company returned without fulfilling their mission. For six long grueling months they had roamed the trackless wilderness in search of the elusive Bay of Monterey. In this they had failed; but their efforts had not been in vain, for instead they had discovered the great Bay of San Francisco, which in spite of the many voyages in its vicinity, had remained so long undiscovered.

Portola took little interest in the new discovery, however, declaring that he saw nothing worthy of description in the "labyrinth of bays and channels which inundated the territory." Under the circumstances, any other man in his position would have felt justified in abandoning the colonization of Alta California; starvation and disease had reduced his forces to a minimum. He was certain now that the supply packet *San Jose* had been lost at sea with its precious cargo of food. But as a soldier of the King, Portola remained steadfast to his purpose. He had been ordered to hold the northern territory and he meant to carry out those orders as long as the strength of his forces would permit.

As the anxious days wore on and the *San Antonio* failed to return, the suffering became even more acute. Some of the soldiers had barely enough clothing left to cover their backs; all else having been given over to the Indians in exchange for fish, geese and other food. A small quantity of corn had been planted where the soil was best, and although it grew well, the birds ate most of it before it matured.

Each day the devout Serra prayed earnestly and fervently that the pitiful group might be spared, through the mercy of Divine Providence, to carry out their mission. Toward evening, on March 19th, the festival of St. Joseph, patron saint of the expedition, the little brown-robed friar stood upon a high bluff and scanned the distant horizon. Suddenly, he dropped to his knees and joyfully gave thanks; for far in the distance, he had sighted the appearance of a sail.* * *

The arrival of the *San Antonio* with the badly needed supplies was a boon to the lagging spirits of Portola and his men. The Governor was now assured of the cooperation and the earnest intentions of the visitador-general in colonizing the country. He determined at once to retrace his steps northwestward and renew his search for the Harbor of Monterey.

The expedition consisted of two divisions, one of which was to proceed by sea and the other by land. Sailing April 16th, aboard the *San Antonio,* were Padre Junipero, Engineer Costanso, Surgeon Pedro Prat and Captain Juan Perez. The land party, consisting of Governor Portola, Father Crespi, Lieutenant Pedro Fages, 19 soldiers, five Lower California Indians and two muleteers, set out a day later, on April 17th.

Shortly after leaving port, the *San Antonio* encountered northwesterly gales, which drove the little vessel several degrees to the south, and delayed it in reaching Monterey for a month and a half.

On land, Portola and his party were experiencing the same difficulty in recognizing Monterey as on their first march. The latitude and landmarks, however, told them they had reached their destination. They explored further and found that between Point Pinos on the south, and a distant headland on the north, lay an immense circuit of smooth water, "alive with sea lions and deep enough for whales." Seven days later, when the *San Antonio* dropped anchor in this harbor, they concluded that it was the long-sought Bay of Monterey, decidedly overrated by Vizcaino.

Upon disembarking Father Junipero looked about and pronounced the port the same as that described by Father Ascension. There were the springs of fresh water; and nearby, the spreading oak on the shore line, where mass had been celebrated in 1602.

June 3, 1770, was the date selected for the ceremonies which would found California's second mission—San Carlos Borromeo de Monterey. Following the elaborate religious service, came the civil and military ceremonies. While the Spaniards, according to custom, uprooted grass and flung stones into the water, symbolizing the seizing of the territory, Governor Portola planted the royal standard—formerly taking possession of the country in the name of His Majesty, Carlos III of Spain. Thus was founded the settlement which immediately became, and for many years remained, the Capital of Alta California.

By 1783, the Franciscan Missions dotted the King's Highway like the beads of a rosary. There were now nine: San Diego de Alcala, San Carlos Borromeo de Carmelo, San Antonio de Padua, San Gabriel Archangel, San Luis Obispo de Tolosa, San Francisco de Asis, San Juan

Mural by Albert Herter. Reproduced by courtesy of Los Angeles Public Library

Capistrano, Santa Clara de Asis and San Buenaventura.

During the long, difficult 14 years, the ingenious Serra had worked hard and relentlessly. With his own hands he transformed the raw, physical products of the wilds into building materials; he hewed trees, sawed up the lumber, and made bricks of mud and straw; he was architect, contractor and master mason all in one. He used no means other than tact and kindness to subdue the superstitious Indians about him, and to teach them to aid in the work. He taught them to plow the fields and plant the crops, that they might be better fed; to spin and weave, that they might clothe their nakedness.

At 70, the Father-President was still active, although slightly stooped, and a little lame from the persistent pain of his ulcerated leg. Through summer's dust and winter's mud, his sandaled feet patiently trod the rough, narrow trail from mission to mission. No matter how arduous the journey, the pious Franciscan adhered steadfastly to the tradition of his order—to walk whenever possible.

Between September of 1783 and January of 1784, he visited each of the missions south of Monterey, administering the rite of confirmation. In the spring he journeyed by way of Santa Clara and paid a last visit to Mission San Francisco de Asis. Then he returned to Monterey and retired to his headquarters at Mission San Carlos, confirming all the neophytes there.

In the illness and pain that attended his last days, he was uncomplaining; and on August 28, 1784, the zealous Servant of God passed quietly away, confident that he had saved more than 10,000 heathen souls.

* * * Today, the name of Junipero Serra is perhaps the most beloved name in California history; revered by men of all classes and creeds. As the founder of the California missions he not only accomplished the spiritual conquest of Alta California, but made possible the physical as well; for without the sustenance provided by mission fields and herds, the Spanish Presidios would soon have withered and died.

While it was the heroic Portola who actually blazed the wilderness trail from San Diego to San Francisco, it was the indomitable Serra who stayed on for 15 long years, to bring into being the settlements of civilization along that trail. The missions which he founded, destined to become important cities, he dedicated to the Glory of God; while the chain that joined them together—California's first highway—he named in honor of the King: "*El Camino Real,* * * * *The Royal Road.*"

As sources of information the author acknowledges:

Theodore H. Hittell: "History of California, Vol. 1, San Francisco, 1885.

The Very Reverend Francis Palou: "Junipero Serra." Translated by the Very Reverend J. Adam, P. E. Dougherty Company, San Francisco, 1884.

George Wharton James: "In and Out of the Old Missions of California." Little, Brown and Company, Boston.

Father Zephyrin Engelhardt, O.F.M.: "Missions and Missionaries of California," Vol. II. Joseph H. Barry Company, San Francisco, 1912.

A. F. S.

Chapter II

Rediscovering San Francisco Bay

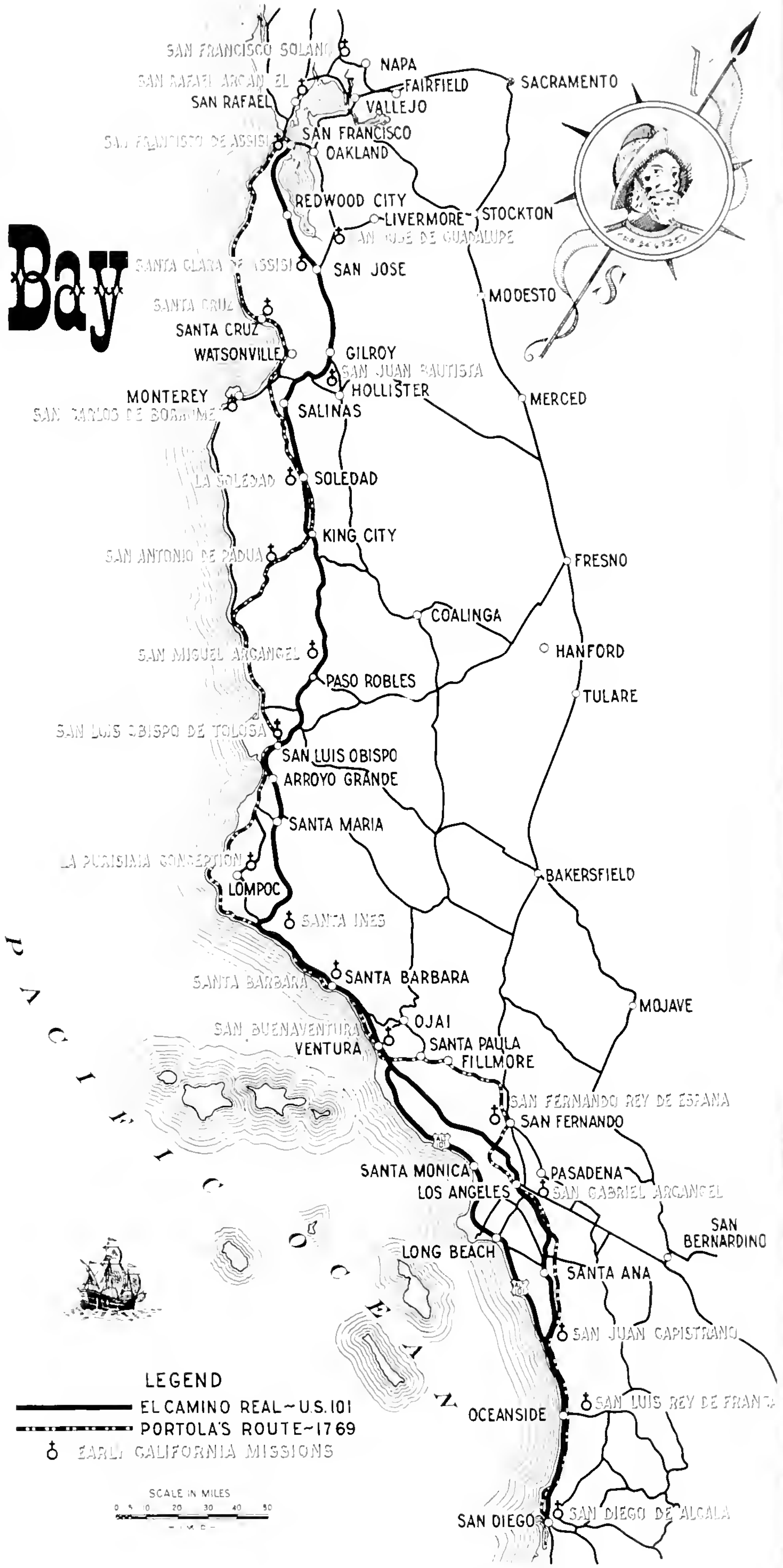
In one of the most remarkable expeditions in history, Don Gaspar de Portola and a company of 63 half-starved, scurvy-ridden adventurers hacked their way through nearly 500 miles of trackless wilderness to accidentally discover the great Bay of San Francisco, and what would one day become one of the world's greatest ports.

Leaving Father Serra to found the mission settlement of San Diego, Portola and his company set out on July 14, 1769, in search of the Bay of Monterey, which Vizcaino had described as an unusually "fine harbor."

In advance of the expedition rode Sergeant Jose Ortega with a scouting guard, locating the best trails and the easiest routes. For miles at a time, the scouting party was forced to cut its way through the dense underbrush to blaze a trail for the cumbersome caravan and its lagging, overladened mules. In a quiet valley, on the banks of a peaceful little stream, or in the seclusion of a wooded canyon, they sought out camp sites for their weary followers.

Traveling northwestward along the coast, the explorers entered what is now Orange County on July 22d. They made camp in a canyon north of San Onofre, near an Indian village, where the Padres baptized two little Indian children whom they found seriously ill. Upon the site was bestowed the name it still bears—Los Cristianitos ("The Little Christians").

The next stopping place is described by Father Crespi, diarist of the expedition, as a very pleasant, green valley, full of willows, alders, live oak and other



trees, with a good stream of pure, fresh water. "We called it the Valley of Santa Maria Magdálena," he recorded. The actual spot selected for the camp was a few miles above the site which Father Serra later selected for Mission San Juan Capistrano.

On the night of July 24th, the expedition made camp on Alisos Creek, near the present site of El Toro. Here they rested for two days before moving on to the Santiago Hills east of Tustin, which they reached on the 26th. Two days later they arrived at the Santa Ana River and set up camp on the left bank, near the present town of Olive, east of Anaheim. Great difficulty was encountered in crossing the swiftly flowing river. Once across, the travelers pursued a northwest course, making camp on a hill near a small pool of water. (The site is now known as La Brea Canyon, north of Fullerton.)

On July 30th, the company crossed the La Puente Hills by way of La Habra Pass, into the broad, fertile valley of the San Gabriel. On August 2d, on the jubilee of Our Lady of the Angels, the pathfinders reached a spot by the river, which they named in her honor: "Rio de Neustra Señora La Reina de Los Angeles de Porciúncula" ("River of Our Lady, the Queen of the Angels of Porciúncula"), present site of the City of Los Angeles.

For several days in advance and during their stay here, Portola and his men encountered a succession of severe earth shocks. They concluded that volcanoes existed in the vicinity, and in searching came upon the La Brae asphalt beds, which Father Crespi referred to as "Rivers of Pitch."

On August 5th, the expedition entered what is undoubtedly Sepulveda Canyon and passed over the mountains into the San Fernando Valley, where they camped near the present site of Encino. On the 7th, they made camp northwest of what was later to become the site of Mission San Fernando. Resuming their march on the 8th, they traveled over San Fernando Pass to the present site of Newhall, camping at an Indian village on the banks of the Santa Clara River, near what is now Castaic.

On August 10, 1769, the expedition left Castiac, in what is now Los Angeles County, proceeding northward through the verdant valley which Father Crespi named the Santa Clara. Close to what is now the county line, the expedition spent the night on the banks of an arroyo in the vicinity of what later became Rancho Camulos. For three successive days, Portola and his men camped near the Indian villages in the neighborhood of what is now Piru, Fillmore and Santa Paula, refreshing themselves on the gifts of food brought to them by the friendly natives.

On the 14th, a campsite was selected near a large Indian rancheria on the coast. Father Crespi named the place La Asunción de Nuestra Señora —predicting, "that such a fine site, where nothing is lacking, will become a good mission." Thirteen years later on this spot, Serra founded the Mission San Buenaventura.

The next night, while camping at another Indian village, the travelers found little rest. Father Crespi recorded in his diary, that the natives "disturbed us and kept us awake, playing all night on some doleful pipes or whistles."—thus accounting for the name bestowed upon the place by the soldiers: Pitas ("whistles") Point.

On August 16th, the wayfarers camped at an Indian village near what is now known as Rincon Point. On the 17th, they reached another village where the natives were engaged in building a canoe. The Spaniards promptly named the place "La Carpinteria" (a name still retained by the town situated near the site).

All along the coast the Indians were numerous. They were friendly, and on the whole appeared intelligent. In the warm August sunshine, the squaws were busy drying fish for the winter, while the men hunted game in the surrounding hills; and in their sturdy canoes, plied back and forth between the Channel Islands and the mainland. On the 18th, Portola and his men reached an extremely large native settlement, on a beautifully situated spot, with oak-studded hills running back from the shore line. (Today on this site stands the City of Santa Barbara.)

Proceeding up the coast along the Santa Barbara Channel, the trail-blazers camped at a site which they named "Gaviota," because of having shot a seagull there. A little farther up the coast they passed Point Arguello, the rocky headland, joining with Point Concepcion to form the corners of California; here the coast line shifts from an approximate north and south angle, to a line running east and west.

On August 30th, they reached the Santa Inez River, and on September 1st, they arrived at Guadalupe Lake, beyond which lay the boundaries of what is now San Luis Obispo County.

During the first part of September, camp was set up in a broad valley where the ground was literally plowed up by the many wild bears that came from miles around to feed on the native roots. Portola's soldiers found sport in hunting down a couple of the ferocious beasts, thereby gaining the profound admiration and respect of the numerous Indians inhabiting the region. They named the site, "La Canada de Los Osos" ("Canyon of the Bears"). Here, three years later, on September 1, 1772, Father Serra founded the Mission San Luis Obispo de Tolosa.

On September 8th, the trailmakers wended their way back to the coast, where they set up camp at the mouth of Morro Creek, on a hill overlooking what is now called Morro Bay and majestic Morro Rock. On the 10th, they stopped at Santa Rosa Creek near the present site of Cambria. The next day they proceeded as far as Little Pico Creek, east of San Simeon Point, where traveling became extremely difficult.

By now, Portola had come to realize that following the coast line presented anything but easy transit. On the 13th, further progress up the coast became impossible, due to the steep mountain precipices. The 14th and 15th, the explorers spent preparing a path over a most difficult pass, and on the 17th, they laboriously made their way over the rough terrain to what is now the boundary of Monterey County.

Pushing inland, the weary party finally reached the San Antonio River, near the present site of Jolon, where they camped on the night of September 24th. Two days later, they descended what is now Kent Canyon, striking the Salinas River near the present site of King City.

The commander and his men followed the stream to its mouth, where they made camp, to rest and make further exploration. On October 1st, they beheld what they believed to be the Point of Pines described by Vizcaino. They failed, however, to recognize the Port of Monterey as that which the navigator had so glowingly described. They were likewise little impressed by the surrounding country, wild and ungracious, with little to greet the eye save rocks, brush and rugged mountains, which Vizcaino called the Sierra de Santa Lucia.

. Portola had expected to find the supply ship San Jose awaiting him at Monterey. Since there was no sign of the vessel, he was certain that they had not yet reached the bay in question, and reluctantly ordered the expedition to proceed farther north.

From here the advance was slow and difficult, as many of the men were suffering from scurvy; some had to be carried on litters. On October 8th, the weary pioneers reached the stream which they called the Rio del Pajaro or "Bird River," because of having found upon its banks a huge eagle stuffed with straw—undoubtedly used by the Indians in a ceremonial.

Just before reaching Soquel on October 10th, the Spaniards first saw the famous "big trees" (*Sequoia sempervirens*), which Portola named the "Palo Colorado" because of the reddish color of the wood. On October 17th, the party camped on the west bank of a large river which Father Crespi named the San Lorenzo, a name which it still bears. (On the campsite, covered with redwoods and wild roses, now stands the City of Santa Cruz.) From here the explorers passed up the coast, halting occasionally to rest their animals and care for the sick.

With early rains slowing their progress, the party, footsore and disheartened, camped on Pilarcitos Creek (site of Spanish Town or Half Moon Bay). Every man in the command was ill; medicines were nearly exhausted.

Monday, October 30th, found them on the march again, battling the rugged terrain. With their meager equipment, they were forced to construct improvised bridges in order to cross several deep arroyos. Further up the shore they were confronted by a formidable barrier of rock. Here the company set up camp, while Ortega and his scouts attempted to find a pass over the Montara Mountains.

By noon of the next day, October 31st, they reached a pleasant spot near the beach, where there was an abundance of large, choice mussels. Father Crespi named the place, "Angel Custodio," while the soldiers dubbed it "Punta de los Almejas," or "Mussel Point." (Today the site is known as Point San Pedro.)

The next day, upon resuming his march, the commander ascended a promontory, and sighted a distant bay, formed by a point running far out into the ocean. He believed it to be the Punta de Los Reyes, which Vizcaino had named in honor of the Three Wise Men of the East; further to the southwest of it, were six or seven small, rocky islands, clearly the Farallons. Portola was certain that this was Drake's Bay, called the Port of San Francisco by Cabrera Bueno, Vizcaino's map-making pilot, whose book he carried with him. He took little comfort in the discovery, however, for it meant that he had passed the Port of Monterey—his real objective.

The men were of divided opinions as to whether or not this was really the Port of San Francisco, as recorded by Vizcaino. While deliberating, the company made camp in what is now the San Pedro Valley, at the foot of the Montara Mountains. It was a peaceful region, traversed by two small streams, which united and flowed into the sea; it was overgrown with reeds, brambles and roses like those of old Castile. There were no trees in the immediate vicinity, other than small willows; only on the distant mountains could any be seen.

When the command had disposed itself for a stay of several days, Sergeant Ortega with a small company of soldiers was ordered to explore the surrounding

On left is Gaviota Pass in Santa Barbara County as it must have looked to Portola and his men who gave it its name because they killed a seagull there. On right is Gaviota Pass as it looks today. Gaviota Pass illustration is from the Vischer painting, courtesy, California State Library

country. On Thursday, November 2, 1769, Father Crespi relates in his diary, that some of the soldiers remaining in camp, saw a number of deer. Obtaining Portola's permission to hunt the animals, the men spent the entire day roaming over the hills to the east. Upon returning in the evening, they enthusiastically related, how from the hilltops, they had seen toward the north, an immense arm of the sea running inland, extending in a southeasterly direction as far as the eye could see.

The next evening Ortega and his scouts returned, heralding their approach by firing off their muskets. They too had seen the great bay. Eagerly, the Governor and his party heard from Ortega, that the Indians had reported there was a port and a ship but two days' journey from their camp site. From this information, Portola immediately supposed that Monterey was close at hand; whereupon, early the next morning, the expedition broke up camp and headed in the direction indicated by the Indians. They traveled northward along the beach for some distance, and then turned off northeast. Mounting the hills, Don Gaspar de Portola and his entire company looked upon the dancing waters of the great bay, apparently four or five leagues across, stretching out below them to the northwest and the southeast. They failed, however, to find the slightest trace of a ship, which led Ortega to believe that he had misunderstood the Indians.

For nearly two weeks, the commander and his men explored the region. They marched down the bay shore and saw the great plains of the Santa Clara Valley, where the Missions of San Jose and Santa Clara were later established.

Although they were undoubtedly the first Europeans ever to look upon the precipitous, rocky portals of the Golden Gate, and the smooth, deep waters of the magnificent bay locked away among the hills, they were little inspired. Hungry and exhausted, they turned around and retraced their steps back to their old camp at the mouth of the Salinas River. It was a grueling march!

Through this pass marched Portola and his expedition in August, 1769

Like virtual living skeletons, the men staggered along day after day, clinging to the hope that the supply packet San Jose might still be sighted.

By December 20th, the food supply was practically exhausted, and the expedition was not even half way to San Diego. "What little still remained could have been eaten by one man in two days," says Father Crespi. In spite of Portola's vigilance, the starving soldiers began stealing from the few remaining sacks of flour; so in order to be fair to all, the commander divided what was left equally

Portola and his men get their first view of San Francisco Bay. From the drawing by Walter Francis, courtesy Bancroft Library

among the men so that each man might guard his own. Each person received eight small cupfuls, and only five very thin tortillas could be made from each cup. In a narrative written some years later, Portola himself described the ordeal of hunger.

"In order that we might not die meanwhile," wrote the commander, "I ordered that at the end of each day's march, one of the week-old mules should be killed. The flesh was roasted or half fried in a fire made in a hole in the ground. The mule being thus prepared, without a grain of salt or other seasoning—for we had none—we shut our eyes and fell to on that scaly mule like hungry lions. We ate 12 in as many days, obtaining from them perforce all our sustenance, all our appetite, and all our delectation."

On November 27th, Portola recommenced an examination of the country in the vicinity of the Point of Pines. Although he camped on the very spot where Monterey was later founded, he failed to recognize in the waters before him, the "sheltered harbor" as described by Vizcaino. After some deliberation as to whether the company should be divided, with one-half returning to San Diego and the others remaining at the Point of Pines, it was finally decided that all would return together. Before starting, the commander set up two great crosses, one on the beach and another on a hill in the Carmel Valley, in full view of the ocean. On the former was inscribed a notice that the expedition had returned to San Diego on December 9, 1769. On the latter were inscribed the words, "Escarba al pié y hallarás un escrito." ("Dig at the foot and you will find a writing.") Beneath the cross a glass bottle was buried, containing a document with a brief account of the expedition. It closed with a prayer to God, the All Powerful, to guide the expedition on its way, and to conduct the navigator who might find the paper, to the port of salvation.

Thus, through the exhaustive sweat and the relentless efforts of California's first pioneers, was carved from the virgin wilderness, the trail which was to become one of the most historic in all California. Although the route missed the sites of several of the missions, for the most part, it became the pathway of the Padres, along which they forged the Mission Chain from San Diego to San Francisco.

One hundred and eighty-one years later, with few deviations, Portola's route is traversed by two of the finest and most scenic highways in the Nation: The beautiful, modern Coast Highway, U. S. 101; and from Santa Cruz north into San Francisco by way of Pescadero and Half Moon Bay, it is followed by State Sign Route 1.

As sources of information, the author acknowledges:

Theodore H. Hittell: "History of California," Vol. I, San Francisco, 1885.

Charles Edward Chapman, Ph.D.: "A History of California, The Spanish Period." The Macmillan Company, New York, 1921.

Herbert Eugene Bolton: Father Crespi's Diary—in the book "Fray Juan Crespi," University of California Press, Berkeley, California, 1927.

Hero Eugene Rensch and Ethel Grace Rensch: "Historic Spots in California (The Southern Counties)." Stanford University Press, 1932.

Charles Caldwell Dobie: "San Francisco, A Pageant." D. Appleton-Century Company, New York, 1933.

John A. Berger: "The Franciscan Missions of California." Doubleday and Company, Inc., Garden City, N. Y., 1948.

A. F. S.

Chapter III

Spain Consolidates Her Holdings

FOLLOWING THE FOUNDING of Mission San Carlos de Borromeo, and the occupation of Monterey, Portola had been instructed by Galves, the visitador-general, to turn over his command to Don Pedro Fages, and return to Lower California. On July 9, 1770, barely eight months after his discovery of San Francisco Bay, he complied with these orders. Leaving about 20 soldiers and a few sailors, too ill to make the return voyage, he departed aboard the *San Antonio* for San Blas, never to return to Alta California.

The intrepid trail blazer had never been overly enthusiastic about the San Francisco Bay region, which he described generally, as a territory indented by a large number of bays and inlets. In the two weeks that his men had scouted the region, he had learned but little. How large the body of water actually was, and how far it extended, no one really knew.

Fages, on the other hand, was eager to explore the newly discovered area; for if the Spanish Crown was to make settlements north of Monterey, he reasoned, it was urgent that the country surrounding what Father Crespi called, "the great arm of the sea," should be thoroughly known. Accordingly, with six soldiers and a muleteer, he left Monterey in November, 1770. Following up the Salinas River, then called the Santa Delfina, he traveled inland. Crossing the barren Gabilan Mountains, he passed north through the Santa Clara Valley, instead of following Portola's original route up the coast by way of Half Moon Bay.

At the southern end of the great bay, Fages and his party traversed the same ground over which Sergeant Ortega had passed in scouting the region the year before. But he proceeded much further north than Portola's scouts, passing over the present sites of the Cities of Oakland and Berkeley. Deeming it unsafe to remain away from Monterey too long, since he was acting without official orders, Fages made no further explorations in the north at that time.

In March of 1772, shortly after his return to Monterey from the founding of Mission San Gabriel, Fages undertook a second expedition to the San Francisco Bay region, at the instigation of Father Serra. The Father-President was desirous that the country be examined for the purpose of ascertaining the most suitable place for a mission settlement. It was still generally believed that the Port of San Francisco lay under Point Reyes, and that the great inland bay, sighted by Portola's expedition, communicated directly with it. The object of the new survey, was to resume the search made by the expedition of 1769, and to continue it around the eastern shore of the bay to Point Reyes and the supposed port.

On March 20, 1772, Fages started from Monterey, with the faithful Crespi, whom Serra had assigned to accompany the expedition. There were 12 soldiers, a muleteer and a Lower California Indian to attend to the pack train. Crossing the Salinas River, the expedition passed through the Salinas Valley, climbed the Gabilan Mountains and dropped down into the valley on the other side, where Mission San Juan Bautista was later established. Continuing north, it passed through the Santa Clara Valley, and on the 22d, set up camp a little north of what is now the City of Gilroy.

On March 24th, Fages and his men reached the head of the bay, camping on a little creek a few miles north of what is now Milpitas. Thence, the expedition proceeded along the eastern shore of the bay, where the explorers saw vast herds of deer and elk; many bears were also encountered.

By the 26th, Fages and his party had advanced as far as the present site of Fruitvale and made camp near the spot where Mills College stands today. On March 27th, camp was made in a marshy region, near what is now Lake Merritt, where the company was much annoyed by the swarms of mosquitoes. It was from an observation point presumably near the present site of the Technical High School, that Father Crespi made his observations of the "Boca del Puerto" (the Golden Gate).

In its march on the 28th, the expedition passed the present sites of Berkeley and Albany, to what is now eastern Richmond, in Contra Costa County. Proceeding to and around the shore of San Pablo Bay, the Spaniards expected to be able to reach the mountains seen to the north of it. But at this point Fages and his men were prevented from advancing further in that direction by the Straits of Carquinez. They turned eastward and made their way along the southern shore of Suisun Bay, to a point on the hills north of Monte Diablo. From here, to their great surprise, they beheld the great interior valley, as level as the palm of one's hand, spread out before them, to the north and the south, as far as the eye could reach. They also observed two great rivers (the Sacramento and the San Joaquin), emptying into the head of Suisun Bay, and "communicating with each other near their mouths by numerous channels."

Realizing that without boats, or being forced to make a most extensive detour, they could go no further in their search for Point Reyes and the port believed to lie under it, Fages now decided to return to Monterey.

On the way back, instead of following the bay shore, the expedition crossed over around the western base of Monte Diablo, through Amador and Suñol Valleys, down Alameda Creek, and on to Monterey by the same route it had come, arriving there on April 5th.

As time went on, and the mission settlements grew, friction arose between

Through these rolling foothills in Contra Costa County marched Don Pedro Fages following a route that is the present day U. S. 40. This section of the highway north of Oleum doubtless was traveled by Fages

Father Serra, President of the Missions, and Fages, Commander of the Presidios. The latter contended that, since the presidios were established to give full protection to the missions, he should have some control over them. Serra, on the other hand, resented Fages' interference. In writing to his old friend Palou, he stated that the hot-tempered Fages had caused "nothing but pain, disgust and discouragement for the religious work, without any benefit to the missionaries." Finally, differences between the two men became so serious, that Serra made the long journey to Mexico City to lay the matter before the new viceroy, Antonio Maria Bucareli. On October 19, 1772, the unhappy Junipero left San Diego aboard the *San Carlos,* reaching the Spanish capital on February 16, 1773.

In compliance with the viceroy's request, Serra submitted a lengthy report on the status of the California missions, in which he discussed some 32 topics. Fearless and candid in his recommendations, the Father-President mapped out a complete program relative to what he thought should be done if Spain was to hold her dominions in remote Alta California.

But first of all, Serra petitioned the viceroy to recall Fages—maintaining that he represented a great hindrance to the mission system. Next he took up the matter of providing more and better vessels for shipping supplies from San Blas to San Diego and Monterey. He related in detail, how for months at a time, the mission settlements were practically without food, as most of the corn and dried meat that arrived from San Blas was unfit for use, being either moldy or full of worms. Nowhere, he argued, were cattle more plentiful than the country around San Blas; yet for nearly two years, the missions had been without meat, depending entirely upon wild game, hunted by the soldiers or the Indians.

He pleaded eloquently for the establishment of a mission in the newly discovered San Francisco Bay region; and urged that an overland route be opened from Mexico into California, whereby, in case of famine, food products could be obtained from the Indians who tilled the rich valleys of the Colorado River. He cited additional advantages from such a land route: In case of encroachment by a foreign power, soldiers could be easily marched overland. Colonists too, he told the attentive Bucareli, could be brought into the country, once such a route was fully established.

All through the conference, the viceroy was unmistakably swayed by the eloquence and the earnestness of Serra's plea. He readily agreed to increase the annual support for each mission. He had given much concern to the lack of order and business procedure which obviously retarded the progress of the Alta California colonies. It now became clear to Bucareli that the distant province must be placed on a more permanent basis, with the result that he drew up the first civil code for California.

There were other matters too, in which the viceroy followed Serra's recommendations: He recalled Pedro Fages as Commander of the Spanish Presidios in California. Although the latter may have failed to perform the duties of this important office to the satisfaction of Father Serra, he nevertheless ranks among the greatest of California's pathfinders. He was the first white man to travel inland from Monterey to the Bay of San Francisco—thereby, virtually charting a portion of the route of the present Coast Highway, U. S. 101. He made the first accurate charting and mapping of the major part of the great bay region, which today is traversed by a vast network of both U. S. and state highways.

From San Jose north, to what is now Warm Springs, the explorer's trail is followed by State Sign Route 17. From Warm Springs to the City of Oakland, it is paralleled by the present Foothill Boulevard.

From the City of Oakland, to the Straits of Carquinez, it might be said that the explorations of Fages and Crespi practically opened the way for the present highway U. S. 40, Northern California's principal artery with the East.

As sources of information, the author acknowledges:

Theodore H. Hittell: History of California, Vol. I., San Francisco, 1885.

Herbert E. Bolton: Fray Juan Crespi, Missionary Explorer on the Pacific Coast, 1769-1774. University of California Press, Berkeley, California, 1927.

Mildred Brooke Hoover, and H. E. and E. G. Rensch: Historic Spots in California. Stanford University Press, Stanford, California, 1948.

—A. F. S.

Chapter IV

Anza Opens First Overland Route

SERRA was not the only one who insisted that a direct land route to California from Mexico was essential. Many had written to the viceroy and the king concerning such a project. "With such a route," they predicted, "Spain can hold the country indefinitely; without it, she will ultimately fail."

But the government itself gave the matter little serious thought, until a certain letter came to the viceroy's attention. It was written by a young Spaniard by the name of Juan Bautista de Anza, a comparatively obscure figure, captain of the small presidio of Tubac in Sonora (a small settlement on the United States side of the Mexican border, about 50 miles south of Tucson). Anza had been born and raised on the frontier of northern Mexico, and had learned the tactics of Indian fighting from his father, a seasoned army man. In his childhood he learned how to travel through the treacherous desert country, where his father was slain by the Indians.

For several years he had made a thorough study of the explorations of Father Eusebio Kino, a Jesuit priest, who as early as 1700, had blazed a trail from Mexico to the junction of the Colorado and the Gila rivers, in an attempt to find an overland route from Sonora to the missions of Baja (Lower) California.

Soon after the founding of the Monterey Mission, Anza had been anxious to lead an expedition from southern Arizona to the new colony. In writing to the viceroy, and offering to conduct such an exploration, he promised that the project would not be too costly and could be accomplished with little difficulty. "My aim is to serve His Majesty and enlarge the Royal Domain," wrote the conscientious soldier.

Anza's letter reached Viceroy Bucareli at a most opportune time; in fact, just about the time Comandante Fages had gone on a bear hunt to keep Monterey from being starved out of existence. Needless to say, the letter received the official's most serious consideration. He immediately conferred with advisors on the northern frontier, among whom was Governor Sastre of Sonora. Entirely convinced of the feasibility of the plan, he called a junta, or conference, with several high-ranking officials, who were responsible in cases where funds had to be provided by the royal treasury.

Then followed further correspondence between Anza and Bucareli, to make definitely certain that the young captain was the man best suited to lead such an important expedition. Anza's cause was furthered materially by the intercession of Father Francisco Garces, the famous priest-explorer. A loyal friend of the Indians, Garces was the first white man to enter the great Colorado Desert, when in 1771, he crossed the Colorado River, mistaking it for the Gila. In his explorations he skirted the Cocopah Range to its terminus at Signal Mountain, near what is now Calexico. He sighted two gaps in the Sierra, through which he believed it would not be difficult to reach the New California.

After more than a year of waiting, Anza received the news that on September 9, 1773, the junta had passed a resolution authorizing him to lead an expedition from Sonora, Mexico, to Monterey, California. The soldier had proved himself the man for the undertaking; he was patient, generous, well liked by the Indians, honorable in the service and of upright life.

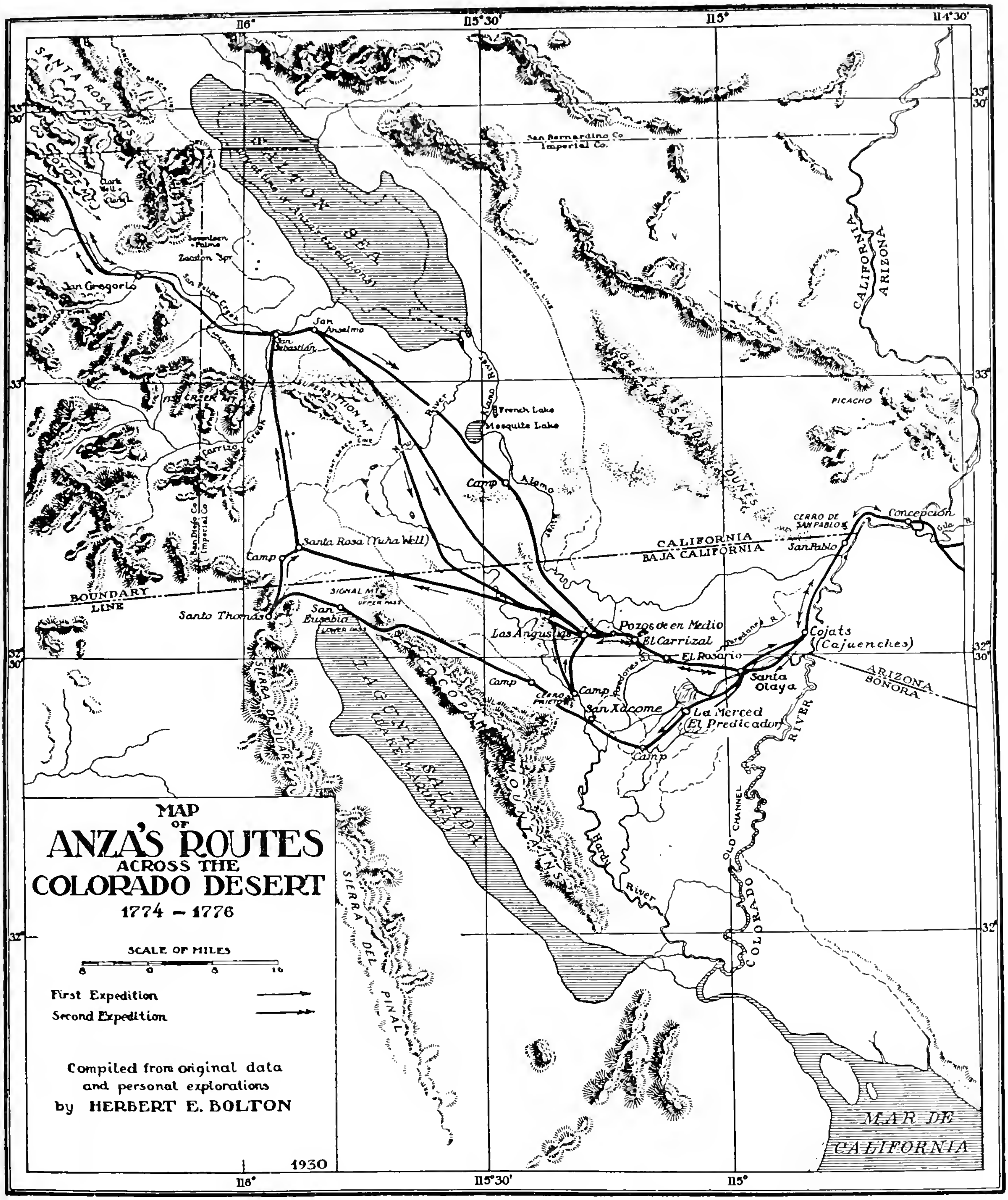
At his own request, the volunteer pathfinder was to be accompanied by Father Garces, Father Juan Diaz and 20 soldiers from his own presidio of Tubac. He was to make no settlements, and was to be held personally responsible for the success or failure of the project. He at once set himself to the task of procuring uniforms, gathering horses, mules and supplies. Pack saddles were repaired and old muskets were cleaned. Father Garces took a lively interest in the work, making himself useful wherever his services were most needed.

Organizing a party and providing provisions for such a trek over miles of unknown desert country was no small undertaking. But in spite of innumerable difficulties, the determined captain was prepared to start in the short space of three months—only to be held back by a daring act of his old enemies, the Apaches. From a safe vantage point, the thieving savages watched Anza assemble mounts and cattle. Horse meat was their favorite food. Under cover of night, they suddenly swooped down from the hills upon his headquarters at the presidio and made off with more than 130 horses, including many choice animals especially marked for the California expedition.

When the stock had been replenished, Anza started from Tubac on January 8, 1774, with a party of 32 people: The two Padres, two servants, five muleteers, two Indians, a guide slightly familiar with the desert country, and the 20 soldiers from his presidio.

At first he planned to travel north, but to outwit the Apaches, who hated the very sight of a white man, he changed his route and headed southwest to Altar. Here he added additional mules and horses, bringing the number of pack train animals to 35 mules and 140 horses; 65 head of cattle were taken along to supply meat for the expedition. A Christianized Indian was also picked up by the party at Altar. Some time before, the neophyte, Sebastian Tarabal, had run away from the Mission San Gabriel with his wife and brother, both of whom had died in attempting to cross the desert. The fugitive had arrived at Altar just as Anza was making his last minute preparations to march; since he had just traversed much of the country over which the expedition was to pass, he was taken along as a guide.

By January 26th with plenty of food and ammunition, Anza now felt himself



Reproduced by courtesy of the University of California Press

well equipped for the task ahead. He left Caborca, a small town a few miles southwest of Altar and with assurance, faced the vast, awesome desert, silent and mysterious, without maps or instruments of any kind.

Upon reaching Agua Escondida, in the shadow of the Gila Range, the Commander met a Sonoita Indian who had just come from the Yuma junction, La Junta de los Rios. He had hastened to warn Anza to approach the Yumas with caution, stating that part of the tribe, those living farthest from the junction, were planning to waylay the expedition, kill the entire party, steal the horses and loot the packtrain.

While the Indian's report caused Anza no great anxiety, it did put him on his guard. He realized that the Yumas controlled any trail that might lead through the territory from Sonora to Monterey. They were a powerful tribe, and he well knew that he must exercise the utmost discretion in dealing with them. After conferring with Fathers Garces and Diaz, he decided to send for Palma, the Yuma chieftain, and ask the latter to meet him on the trail. Promising the Indian messenger a generous reward, he forthwith sent him back to the Yuma camp to bring the great Palma.

Meanwhile, the expedition kept up its march. The next day, the messenger returned, but instead of Palma, came a Yuma headman and eight braves. The headman made a speech, which an interpreter repeated to Anza, to the effect that Palma was absent from the village; at the same time, he made it clear to the commander that the great chief and all his people meant the Spaniards no harm. He insisted that they must come at once—promising them a friendly welcome.

At the Yuma camp, Anza and his men were objects of curiosity for the simple-minded natives, many of whom had never seen a white man before. At five in the afternoon, Palma himself appeared and received Anza most hospitably. The commander returned the compliment by distributing among the Indians tobacco, beads and toys. In an impressive ceremony, he placed about the neck of the chief a piece of red ribbon from which hung a likeness of the King of Spain.

The next morning the caravan crossed the Gila. Palma generously offered to have the cargoes carried across on the heads of his tallest and strongest braves. They also carried the venerable Garces across, as the padre could not swim, and would rather trust his Indian friends than a horse. By three o'clock in the afternoon the crossing had been made with entire success.

The next day, February 9th, came the crossing of the Colorado. Here the packs were carried over by the mules instead of on the backs of the Indians. In celebration of the feat of crossing the mighty Colorado, which Anza claimed had never been done before by the arms of the king, the commander ordered the firing of a salute of musketry.

That night, the expedition set up its first camp on California soil. The next day the Spaniards resumed their march traveling a distance of four leagues along the river where it turned south, passing Pilot Knob,

The giant sand dunes of Imperial County blocked the way of Anza and his men in their overland march into California from Mexico in 1774

In 1926, engineers finally conquered the forces of nature, when they constructed the elevated highway, comparable with all other modern highways, over the formidable sand hill area which almost defeated Anza

which Anza named the Cerro de San Pablo.

The explorers were now just above the boundary line. They continued in a southwesterly direction until they reached a lake, named by Anza Laguna de Santa Olaya, situated about 12 miles south of the present boundary line and eight miles west of the Colorado.

This was the end of the known land. Beyond lurked hostile Indians; and barring their way into what is now Imperial County lay endless leagues of giant sand dunes, as treacherous as the shifting sands of the Sahara. The desolation and loneliness of the region was enough to try the soul of even the most venturesome.

For days the disheartened pathfinders wandered over the unfriendly desert country, fighting their way through the whirlwinds of choking sand and suffering unbearably from thirst. The animals were sorry to behold. Weak and wobbly, with their bones protruding through their hides, they had become miserably ill from foraging on a particular herb in the absence of grass. It was now 10 days since Anza had left Santa Olaya. By one long, difficult league after another he had pushed his way into the desert, with its brackish pools of water, its blinding alkali wastes and poisonous reptiles. After spirit-killing effort, the overpowering dunes proved utterly impassable; and the exhausted company was forced to crawl back to its Colorado base at Santa Olaya, where the water was fresh and the meadows green.

At the Colorado, Anza came to the decision that the only way he could ever reach his destination was to travel light. He placed in Palma's charge the greater

This is the old plank road across the sand dunes before highway engineers found a solution of the problem of drifting sand

part of the cargoes, with mules enough to transport it to his village. He left also the disabled cattle and saddle horses. To care for his property, he detailed three trustworthy soldiers, three muleteers, one of his own servants and two Pima Indians.

At the oasis, among the friendly Indians, Anza and his weary company rested for several days. They resumed their journey on March 2d, finally reentering California five days later. They set up camp about three or four miles southwest of what is now the Yuha Well (Imperial County), and about two miles north of the present international boundary line.

The next morning they discovered a little group of wells, typical desert pozos dug into the sand, which when opened, "poured forth an abundance of the finest water." The entire Yuha basin (six miles southwest of Dixieland), where the lifegiving springs were located, was literally covered with myriads of fish fossils, beds of decaying oyster shells and the most amazing rock concretions of various forms and sizes, resembling petrified fruits, flowers and vegetables. Because of the unusual rock formations, Anza named the wells, Pozas de Santa Rosa de las Lajas (the Wells of Saint Rose of the Flat Rocks).

In their trek over the dry, level plain the Spaniards suffered another grueling day without water. But the Indian Sebastian kept assuring Anza that water was not far distant. Looking north from the wells of Santa Rosa, the neophyte had recognized the gap through which he had emerged from the mountains. At the moment, however, traveling was even more difficult. Between Fish Creek Mountain on the left, and Superstition Mountain on the right, the expedition encountered more sand dunes. To lighten the burden for the horses, the men dismounted and proceeded on foot. After traveling seven long, hard leagues, more than 20 miles, skirting Carrizo Creek the last half of the way, Sebastian's promise came true. In his honor, the commander named the watering place San Sebastian. The spot, which is now known as Harper's Well, is situated at the base of the San Jacinto Mountains (approximately four miles west of Kane Springs, on U. S. Highway 99, between Indio and Brawley).

The Borrego Valley, traversed by Anza's expedition in 1774, is now a part of the Anza Desert State Park, in San Diego and Imperial Counties. The park area is reached via State Sign Route 78. (Courtesy California State Division of Beaches and Parks)

On March 12th and 13th, the expedition camped at San Gregorio, at the entrance to Borrego Valley, where the famished animals gorged themselves on the welcome forage. Leaving San Gregorio on the 14th, Anza swung northwestward, ascended Borrego Valley to its head and entered Coyote Canyon. Having traveled six leagues, he camped next at the refreshing springs of Santa Catharina. (Reeds Springs or Lower Willows.) Jubilantly, Anza recorded it as "a spring or fountain of the finest water, which runs for about two leagues, having willows most of the way. Here was found much grass and other green plants, as well as wild vines and trees, which announce to us an improvement in the country from here forward."

On March 15th, after another long, hard pull, the party reached the summit of the San Jacinto Range, passing through the Royal Pass of San Carlos, the first inland gateway to the coast of California, located near what is now the southern boundary of Riverside County, some 20 miles west of the junction of the present Riverside, Imperial and San Diego Counties.

On March 16th, the caravan passed through the Cahuilla Valley to Laguna Principe (now known as Dry Lake). Following the Bautista Canyon, it descended the mountain to what is now the San Jacinto River. About three miles above the present site of San Jacinto, the travel-weary trailbrazers made camp in a shady grove of cottonwoods.

The indomitable captain from Tubac and his loyal band of followers were nearing their goal. On March 19th, they camped at the western end of San Jacinto Lake (now dry). Turning west the next day, they passed the present site of Moreno, on their way through what is now the Allessandro Valley. Undoubtedly, they descended from the ridge by way of the present Sycamore Canyon.

Traversing the present site of Riverside, the wayfarers halted near an Indian village on the banks of the Santa Ana River (about three miles south of Mt. Rubidoux). Here they constructed a bridge of logs across the swiftly-flowing river and entered the last lap of their long, wearisome trek.

On the 21st, they entered what is now San Bernardino County, passing close to the present site of the City of Ontario. On March 24th, at sundown, they arrived at Mission San Gabriel (at its original location, about five miles south of the present site).

At the Franciscan settlement the wildest excitement prevailed. "Even though the friars and soldiers saw us," Anza states in his diary, "they could hardly believe that people could have come from Sonora; and kept repeatedly asking me if it were true. Tears

The new (upper) and old (lower) Cuesta Pass highway. It was through Cuesta Pass that Anza found his way in 1774

sprang to their eyes caused by the joy and pleasure at seeing an expedition accomplished, and at knowing how close at hand Sonora was and how easy the transit from it."

When the burst of sentimentality and play of emotions began to subside, everyone was faced with the stark realization that the mission's supplies were dangerously low, due to the failure of the supply ship to arrive. Since Anza had been forced to leave most of his supplies in care of Palma at the Colorado base, starvation faced the settlement. The generous Father Paterna, superior of the mission, willingly offered Anza a portion of his meager store, but even at that, there was not enough to support the expedition on its journey to Monterey.

But just when things seemed their worst, news came that the *Nueva Galicia* had arrived at San Diego, bringing supplies and likewise Father Serra, en route home from Mexico. Immediately Anza and Father Paterna organized a pack train to go to San Diego for provisions. Fresh mounts were also to be brought back, as Anza's animals were in a pitiful condition.

At first it had been decided that Anza and Father Garces should accompany the pack train to San Diego; but as the rivers were rising at an alarming rate, they deemed it best to remain; instead, they sent four soldiers with 15 pack mules to bring back the supplies.

Two days later, the rivers subsided, and Father Garces set out belatedly behind the train. At San Diego, the priest-explorer had his first meeting with Father Serra, who was preparing to travel to Monterey by land.

By April 1st, the pack train was ready to start back to San Gabriel, followed five days later by Serra and Garces. Upon his return to San Gabriel on April 11th, several days after the arrival of the pack train, Father Garces was sadly disappointed to find that Anza had already left for Monterey.

The commander had completely changed his plans when he learned that no mounts could be spared from San Diego. Also, the provisions were woefully inadequate, with much of the food unfit to eat. He decided that the only solution was for some of the men to go back to the Colorado River. He took with him to Monterey four of his own men and two from San Gabriel to show him the way, leaving word that the rest, accompanied by Fathers Diaz and Garces, should return to the Colorado to wait for him there.

Anza's trip to Monterey was made with little difficulty. The route was well charted by those who had passed over it in the five preceding years: Portola's expedition had traversed it twice; Fages had traveled it numerous times; and Serra had already been over it once.

Leaving San Gabriel on April 10th, the commander followed the Rio de la

Porciuncula (Los Angeles River) into the San Fernando Valley, turning west around the point of the mountain, west of the present site of Glendale. On the night of the 11th, he camped near the present site of San Buenaventura, on the river by that name, in what is now Ventura County. The 13th found him at the mouth of the Santa Inez River, in what is now Santa Barbara County. On the 15th, he made the long ride from the Santa Inez River to Mission San Luis Obispo, a distance of nearly 50 miles.

From San Luis Obispo, Anza traveled inland, crossing the Santa Lucia Range through Cuesta Pass. Descending into the Santa Margarita Valley, he turned northwest, passing over the present site of Paso Robles (Pass of the Oaks) to San Marcos Creek. From there he traveled almost due north to the Nacimiento River and on to the first crossing of the San Antonio River, to about King Well, in what is now Monterey County.

Within three days from the time he left San Luis Obispo, the hard-riding captain was in Monterey, having completed a journey of four hundred miles in nine days. At Monterey he was hailed as the hero of the hour. Comandante Fages and Father Palou were on hand to welcome him. Special mass was celebrated in his honor. * * *

But Anza was a soldier, a man of action, little given to pomp or social life. After three days' stay, he was again in the saddle on his way back to Mexico. At San Gabriel he remained only one day, crossing the inhospitable desert and camping at San Sebastian on the night of May 7th. From that point, he made a short cut directly across the desert to Yuma, arriving there May 10th.

From Yuma, Anza chose a different route to return home. Striking north, he followed up the Gila River where he found the Indians peacefully cultivating their fields. The closer he came to Tubac, the faster he rode, arriving there May 26th, a day ahead of the rest of his party.

The commander was given a royal welcome; but while he was being showered with honors, he also received the disappointment of his life. At the presidio he found Antonio Bonilla, adjutant inspector, who needlessly detained the impatient pathfinder for several months. When he was finally released, he hurried on to Mexico City, where he arrived early in November.

At the capital, Anza was the idol of the city. He had accomplished what others had dreamed of for more than a century. With all the ceremony due a royal personage, he was received by the government officials, and was elevated by the grateful viceroy to the rank of Lieutenant-Colonel of Cavalry.

But with all the praise and honors that were heaped upon him, the former Captain of Tubac modestly rode back to his little presidio, content that he had faithfully served his country and his king.

The achievement of Don Bautista de Anza, in opening an overland road into California, stands out as one of the most dynamic steps in the development of the great empire of the West. His desert trail across what is now Imperial Valley was later followed by a long line of traders, trappers, argonauts and homesteaders. At various times it was known as the Sonora Road, the Colorado Road, the Emigrant Trail and the Butterfield Stage Route.

Today, a major portion of Anza's original route is traversed by modern U. S. and state highways. From Yuma to Dixieland in Imperial County, a portion of his trail is traversed by U. S. Highway 80. Engineers have now subjugated the famous sand hills of Imperial County, which presented so formidable a barrier to Anza's expedition.

In 1916, the first attempt was made to bridge the area with pine planks. Eight years later another experiment was made when redwood timbers were used. In 1926, after engineers had made a careful study of the movement of the dunes over a period of several years, the present road was constructed through the dune area, comparable with all other modern highways. By elevating the new road to the height of the tops of the surrounding dunes, with steep embankments to prevent the sand from drifting over the road, man finally conquered the forces of nature.

In San Diego and Imperial Counties, Anza's trail, through what is now Anza Desert State Park, runs close to the Julian-Kane Springs Highway, State Sign Route 78.

Juan Bautista de Anza, founder of San Francisco. From a painting by Herter. Courtesy Los Angeles Public Library

Just south of Hemet Valley, in Riverside County, the historic route is paralleled by State Sign Route 79. Near Riverside, it is traversed by U. S. 60.

In San Bernardino County, following the present route of U. S. 60, Anza's trail crossed what is now Euclid Avenue, that long, tree-lined drive, extending north and south through the modern towns of Ontario and Upland.

From Mission San Gabriel in what is now Los Angeles County, to Monterey, the illustrious trailblazer triumphantly completed his stupendous project of opening an overland route into California from Sonora to Monterey, by following the Mission Trail, El Camino Real, which in turn laid the pattern for the present Coast Highway, U. S. 101.

As sources of information, the author acknowledges:

Herbert Eugene Bolton: Anza's California Expeditions (in five volumes). University of California Press, Berkeley, California, 1930.

Mildred Brooke Hoover and H. E. and E. G. Rensch: Historic Spots in California. Stanford University Press, Stanford, California, 1948.

—A. F. S.

Chapter V

The Founders of San Francisco

PART I

In November, 1774, the Spanish Capital at Mexico City was seething with excitement over the news that Captain Don Juan Bautista de Anza had opened an overland route into California. A thorough study of the trailmaker's diary and report by government officials strengthened the viceroy's decision to commission Anza to lead a party of colonists overland, to form the nucleus of a settlement to be established on the Bay of San Francisco.

Previously, in May of 1774, Viceroy Bucareli had ordered further surveys of the bay area before attempting the founding of a settlement in that region. His orders reached Monterey in July of that year. On November 23d, Captain Rivera y Moncada, who was to replace Fages as Comandante of the Presidios, accompanied by Father Palou and 16 soldiers, left Monterey for the north. They traveled the same route taken by Fages in 1772, passing what is now Gilroy, and on through the Santa Clara Valley. On their way through what is now San Mateo County, they traveled northwestward along the bayshore; and on account of swampy places, ascended the hills and followed Portola's route. On November 30th, the festival of St. Andrew, they came to the peaceful little valley, which they named San Andreas in honor of the saint (a name which it still retains).

Proceeding almost due north, passing by Lake Merced, and crossing the sand dunes, they arrived at Point Lobos on December 4th. Here on the summit of the hill (close to where the Cliff House now stands), looking down upon the jagged points of the Seal Rocks on one side, and upon the deep rocky cliffs guarding the entrance to the bay on the other, Father Palou erected a cross. Then, due to the almost incessant rains, the expedition made no further surveys, but returned to Monterey.

Heartened by the success of Anza's expedition, in the latter part of 1774, Bucareli ordered the establishment of a presidio at San Francisco and the founding of two missions, one at San Francisco and another at Santa Clara. The ship that brought the joyful news to Father Serra at Monterey was none other than the *San Carlos,* the historic vessel that had carried the first seaborne division of pioneers to San Diego in 1769.

Reaching Monterey on June 27, 1775, the *San Carlos* was under the command of Juan de Ayala, a lieutenant of the Royal Navy. The lieutenant had been instructed by Bucareli that after delivering his dispatches and unloading part of his cargo he was to proceed to and make a survey of what Vizcaino had called the "Port of San Francisco," believed to lie under Point Reyes. He was further to ascertain particularly whether the canal or arm of the sea, that had been discovered by Portola's expedition in 1769, and again surveyed by Fages and Crespi in 1772, communicated directly with the port in question.

Ayala set sail from Monterey on July 27, 1775, and cautiously crept up the coast. In nine days he arrived off the heads. For exploring operations he was equipped with a sturdy launch, which he had ordered his carpenters to construct from a large redwood tree before leaving Monterey.

Just off the heads, Ayala sent the launch ahead to explore the narrow passageway, now famous the world over as the Golden Gate. Seeing that his men had no difficulty in entering the inlet, Ayala followed on the *San Carlos*. Although darkness came on, he continued his course, since the water was deep and the way clear. On the memorable night of August 5, 1775, the *San Carlos* sailed through the pillared gateway, the first ship, as far as is known, ever to enter the Bay of San Francisco.

For nearly 40 days, Ayala explored the great landlocked bay. In his launch, he surveyed almost the entire coastline, going up as far as the junction of the Sacramento and the San Joaquin Rivers. Besides proving that the bay had but one inlet, he completely disproved the belief that it was connected by water with Drake's Bay. In his report to Viceroy Bucareli, Ayala asserted that the new port, which was beginning to be known as the Port of San Francisco, was one of the finest in the possession of Spain.

Meanwhile in distant Mexico, preparations were under way for the organization of Anza's colonial expedition. In organizing and managing the second expedition, the Lieutenant-Colonel was given full power to act. He was privileged to choose his own leaders and soldiers, as well as the number and caliber of the people who would make up the expedition. Intrusted to his judgment, was the kind and amount of provisions and supplies that would be needed on the trip. In short, he was to be personally responsible for the entire colony, until it reached its destination.

As the best material for colonists, Anza selected people from the districts of Culiacan, Sinaloa and Fuerte, in the province of Sonora. "Most of these inhabitants," the Colonel told Bucareli, "I have seen submerged in the direst poverty and misery, and so I have no doubt they would most willingly embrace the advantage which Your Excellency may deign to afford them."

Much thought was given to the method of payment, whether the recruits were to be paid in cash or in commodities. Anza favored the latter method, as he well knew the weakness of these people for prodigality and gambling.

Since most of the soldiers were taking their families with them, and would therefore be weighed down with responsibility, Anza requested that he be allowed to take 10 of the soldiers from

In 1775-76, Anza led the first settlers overland from Mexico to California. The party numbered some two hundred and forty persons, most of whom were women and children. From the drawing by Walter Francis, courtesy Bancroft Library

his own presidio of Tubac, who had accompanied him on his first expedition. Then there must be a sufficient number of good mounts, for between Culiacan and San Francisco Bay lay a distance of more than 1,500 miles.

There must also be presents, with which to win the favor of the Indians along the way: Tobacco and a quantity of brilliantly-colored glass beads. Something extra special must be taken along for Palma—a suit, perhaps, with jacket and buckskin breeches; a blue cloth cloak, trimmed in gold; and a cap with cockade, like that of the dragoons.

All through the spring and summer of 1775, Anza and Bucareli worked ceaselessly. Tailors, gunsmiths and saddlers were prodded for rush orders. Then from Mexico City to distant Culiacan the equipment was hurried by pack mule.

Anza had hoped to be at Tubac in time to make the final start by the end of September. But before he could get there with his colony, the Apaches repeated their villainous act of the year before by swooping down on the presidio and running off the entire herd of horses.

Thus, the commander had suffered an almost irreparable loss, since horses and mules were comparatively scarce in that district. To make matters worse, a stampede at Horcasitas, capital of Sonora, where the caravan was assembling, caused the loss of additional horses and mules.

With the greatest effort, Anza gathered as many new animals as possible, many of which were of inferior stock. On the morning of starting from Horcasitas, September 29th, mass was celebrated with all the solemnity possible by Father Pedro Font, Chaplain for the expedition. Since the caravan was such a long one, it had not been possible to start before afternoon. At half past four, the bugle sounded and amid parting tears the march began.

Officers of the San Francisco Colony were Don Jose Joaquin Moraga, lieutenant, and Pablo Grijalva, sergeant. In advance of the train rode several soldiers, to mark the best places for the caravan to follow. Anza, leading his party, was followed by Sergeant Grijalva and Father Font, while Lieutenant Moraga followed behind the train to pick up lost articles and to prevent an Indian attack from the rear. Following the leaders came a company of soldiers, equipped with shields, lances and carbines, wearing sleeveless coats made of several thicknesses of deer skin, to ward off the poisoned arrows of the Indians. Following, came their families and those of the civilian settlers, riding horses and mules. In the rear rode the servants, Indian guides and the muleteers with their heavily-ladened pack train, consisting of around 140 mules. It was a motley procession of some 177 souls: Women approaching motherhood; others with babes-in-arms; children of various ages, all part of the historic train that was to people His Majesty's dominions on the distant Bay of San Francisco.

The first major stage of the long journey was from Horcasitas to Anza's presidio of Tubac, a distance of about 200 miles. It was a trip fraught with difficulty; one which would have disheartened a less courageous soul than the heroic Anza. Every day it took several hours to break camp and load up. The mules were unbroken and many of the muleteers were inexperienced. The unseasoned animals, unaccustomed to the heavy packs, soon became exhausted: many of them ran away. Packs were continually falling off and baggage was lost.

It was the fifteenth of October, 1775, that the expedition reached Tubac, where it was held up for several days while Sergeant Grijalva brought his family from the presidio of Terrenate. Father Garces and Father Tomas Eixarch joined the party, to go as far as the Colorado River, where they were to work among the Yumas at the Gila-Colorado junction.

With everything in readiness by October 23d, the mammoth train, now numbering 240 people, began its 100-mile journey to the Gila River. The first night in camp, tragedy struck. At La Canoa, on the River of Tubac, Señora Feliz, the wife of a soldier, died in childbirth, leaving a bouncing baby boy and seven other children to be cared for by the other women in the party.

Day by day, the colonists plodded along, eating the scanty diet, thirsting between the dribbling desert pozos, which were sometimes miles apart. By late November, they reached the Gila River where Palma came to meet them. On the 28th, the caravan moved down the Gila, made the crossing and set up camp near the junction of the two streams. Then came the commander's first major problem: The crossing of the mighty Colorado. On his first expedition, with hardy soldiers, all seasoned frontiersmen, it had been a comparatively easy matter. But with 30 women and 136 children, so much baggage and stock, it was a far different story!

Matters were further complicated when Anza learned that the ford used the year before was no longer passable. He next considered crossing the river on rafts; but the Indians objected, complaining that the water was too cold for the swimmers who would have to guide the rafts. Moreover, they contended that it would take a day's labor to get each raft load across, necessitating a delay of several days. So the ingenious Colonel mounted his horse and with one of his most trusted soldiers rode out to look for a favorable ford. All morning the pair struggled through brush and morass, until they finally found a place where the river divided into three channels, forming two islands. Upon returning to camp, Anza sent men out with axes to clear a trail to the ford.

The next morning, November 30th, camp was shifted a quarter of a mile upstream to the ford, so that packs could be moved across in half loads. The women and children were taken across on the backs of the largest and tallest horses. As before, the good Father Garces was carried across feet first, on the trusty shoulders of the Yumas. It took three hours to make the crossing, but by 1 o'clock, people, pack animals, stock herd and most of the baggage were safely on the other side of the broad stream.

On December 3d, camp was made at Palma's village, where the native chieftain gleefully modeled the new outfit sent him by the appreciative viceroy. The next morning the party started out again, swinging west along the brush-covered bottom lands, making camp that night about a league beyond Cerro de San Pablo (Pilot Knob).

Anza was cheered by the news brought back by his scouts that they had found the water holes the same as the year before, and that they had found a way through the sand dunes, where the first expedition had been turned back. But there was much to disturb the com-

mander's peace of mind nevertheless. Mesquite, tornillo and cachanilla delayed pack mules and cattle; some of the animals were lost. It was now growing bitterly cold, and with each passing day the sick list grew longer. The animals were falling with exhaustion; on the night of the 5th, a mule and a horse died.

But weary spirits were soon revived when the caravan reached Santa Olaya on December 6th. As before, the spot was a virtual land of plenty for both man and beast. Anza recorded that the friendly Indians brought all sorts of food: Vegetables, and "more than 2,000 watermelons of enormous size," held over from the fall crop by being buried in the sand.

For three days, while the people and the animals rested and recuperated, the commander calculated and planned for the journey ahead. He came to the decision that in order to conquer the desert, the expedition would have to be divided into three divisions, with each starting a day apart. It was a dangerous plan, but the only way, if the scanty watering places were to hold out. He and Father Font would accompany the first division: Sergeant Grijalva the second, and Lieutenant Moraga, the third. The vaqueros and the rest of the soldiers were to leave on the 10th, and were instructed to go directly from El Carrizal to San Sebastian, to relieve still further, the drain on the water holes. For their own use, the men would carry water in skin bags, but the cattle would have to go without.

On the 9th, Anza's division started out with the Wells of Santa Rosa as its destination. Before leaving, every person filled his water bag, and as an extra precaution, was required to carry a supply of maize and a bundle of grass for the animals.

On the way, the colonists, accustomed to the warm climate of the Mexican interior, suffered unbearably from the cold, bitter winds and the violent snowstorm that held the entire plain, from the Colorado River to the California mountains, in its icy grip. But in spite of hardships, they managed to travel a distance of seven leagues over the old trail to El Carrizal.

The second day, they suffered even worse. As far as Los Augustias, the route still followed Anza's old trail; but from that point westward, it was virtually unknown, save for a brief exploration by the scouts. With each step of the way, the sand grew deeper and more difficult for the tired horses. After stumbling along for seven long, hard leagues, the half-frozen wayfarers and their gaunt, weak animals halted at a dry barranca (undoubtedly the channel of the New River). There was no water, nor pasture for the animals; but fortunately, Anza's forethought had provided the poor beasts with a bit of sustenance at least.

The Presidio of Monterey, much as it looked when Anza led the San Francisco colonists there in 1776, on their way north. Cut courtesy California Highway Patrolman Magazine

It was a pitiful group that made camp that night! While tents were being set up, mothers numb with cold, gathered their shivering, hungry broods about them, and huddled before the feeble fire of dried mesquite twigs. All the while, the tender-hearted commander and Father Font, himself ill, bent every human effort to alleviate the misery of their wretched followers.

December 11th was "blue Monday" indeed for the poor colonists; it was the most grueling day of the whole march thus far. The anxious commander was up at 3 o'clock, feeding grain to the animals. Packs were stripped of all extra clothing to bundle up the women and children. Men were sent ahead to open the wells at Santa Rosa. Then for 11 long tedious hours the division laboriously threaded its way through the monotonous dunes. There were times when many were forced to dismount and literally push their lagging animals through the deep sand. But by 6 o'clock, well after nightfall, they reached Santa Rosa, having traveled a distance of 35 weary miles.

To Anza's great disappointment, the wells were running slowly. He and his men at once set out to deepen them, working from 6 that evening until 10 o'clock the next day, before all the animals had been watered. Man and beast alike were suffering from fatigue, but time was precious. They must push on immediately if enough water and forage was to be saved for the two divisions just behind them.

On the 13th, the first division reached San Sebastian over the original trail past Superstition Mountain. Here Anza decided to await the rest of the party, as there was water and grass, carrizo and mesquite for the cattle. There was also brush for firewood, an important item, since the weather was bleak and bitterly cold. Roundabout, the Sierras were white with snow. It was a winter such as the oldest living Indians had never experienced before.

On the 14th, Anza was cheered by the arrival of the cattle herd. The next day, Grijalva's division arrived, with most of the people "half dead from the cold." Because of the snow, Moraga's division was forced to spend three days on the road between El Carrizal and Santa Rosa, arriving on the 17th, with many of its members severely frozen. Although numerous horses and mules fell by the wayside, "by the grace of God," Father Font recorded, "the people escaped with their lives."

From San Sebastian, the expedition followed the same trail Anza had charted the year before. Christmas Eve, December 24th, found the commander and his people at the upper end of rain-swept Coyote Canyon (at Upper Willows, or

Fig Tree Spring). Here, appropriately for the season of the Nativity, a baby boy, Salvador Ignacio, was born shortly before midnight to the wife of one of the soldiers.

Resuming its journey on the 26th, the train, now considerably shortened by the loss of so many animals, continued on over the old route with one variation. Having passed through the Paso Real de San Carlos, the summit of the sierra, the party reached Lake Antonio Bucareli (Lake San Jacinto) on December 29th. Anza now traveled past the present site of Lakeview, through Bernasconi Pass and across the present Allessandro Valley, by way of what is now March Field. He halted at his old camp on the Santa Ana River, where the colonists watched the old year out.

Once again, Anza had conquered the desert! He had surmounted the Sierra, and was now within three days' march of Mission San Gabriel, where scouts had already been sent to announce the coming of the caravan.

PART II

Since Anza's former visit, the Mission had been moved about a league north of its original site, where it would be safe from inundation by rampaging flood waters. It was anything but an imposing establishment, built of logs and tule. But shortly before noon, on the morning of January 4, 1776, it was a welcome sight to the eyes of the weary wayfarers; the first Spanish settlement they had seen since leaving San Xavier, 600 miles away in distant Mexico. They were warmly received by the kindly padres, who graciously offered the colonists the humble hospitality of the mission.

Waiting for Anza at San Gabriel was Captain Don Fernando Rivera y Moncada, Commandante of the Presidios of California, who had replaced Don Pedro Fages. At the Santa Ana River, Anza had received word of the Indian uprising at San Diego Mission. Rivera now confirmed the report, stating that the mission had been fired, and that a priest, the mission carpenter and blacksmith had been killed. He felt that since he had only 10 soldiers with him, all that could be spared from the presidios, Anza should accompany him to San Diego, to help him put down the uprising. Besides, he argued that the roads were so bad it would be impossible for Anza to get his colonists to Monterey immediately.

Obligingly, Anza and Father Font, with 17 soldiers left with Rivera to round up the Indian murderers. Traveling south, they followed precisely the route opened by Portola six years before, which had now became a well-traveled trail, known as El Camino Real (The King's Highway).

It was not long before Anza learned that the real purpose of Rivera's plan was to delay the founding of San Francisco. By the middle of February, the three men were still at San Diego, wrangling over the question of proceeding north. Undoubtedly prompted by jealousy, the Comandante insisted that the port of San Francisco had been greatly overrated: "There is nothing there to warrant a settlement of any kind," he flatly asserted, and even went so far as to propose that Anza and Father Font turn the expedition over to him and return to Tubac; whereupon the grim-visaged Padre replied stubbornly: "No, Señor, we must comply with our instructions and do our duty—which is to go to Monterey, and from there, to proceed to explore the Port of San Francisco." Anza, now well aware of Rivera's motives, was also adamant.

Momentarily, however, the commander's difficulties with Rivera were overshadowed by a disturbing message from Moraga, who had been left in charge of the expedition at San Gabriel. Provisions at the mission were nearly exhausted, forcing Father Paterna to put the colonists on half rations. Discontent was rife, Moraga stated, and the colonists were complaining bitterly of the long delay.

Anza was gravely concerned, and hurriedly made arrangements to send a pack train to San Gabriel with supplies. Since Rivera was now openly showing himself

The Presidial Pueblo of San Francisco, with the Fort and the "Boca del Puerto," (Golden Gate) 1830

adverse to the establishment of a presidio at San Francisco, refusing to accompany Anza and Font north to select a suitable site, the pair left for San Gabriel without him.

At the mission there was more bad news. The night before five men had deserted. A soldier of the mission guard, a servant and three muleteers rifled the packs and made off with a variety of goods, including two muskets, a saddle and 30 or more horses and mules, some belonging to the mission, and the rest to the individual members of Anza's expedition. A few hours before the arrival of Anza and Font, Lieutenant Moraga had set out after the culprits. It resulted in a long, hard chase of more than 200 miles, but the horses were badly needed; moreover, discipline was at stake.

Meanwhile at San Gabriel, the commander was growing restless and the people were grumbling over the delay. Believing that action was the best remedy for all concerned, Father Font insisted that the caravan start at once for Monterey. Accordingly, on February 21st, Anza set out, with all but 12 families, which he left at San Gabriel to follow later, accompanied by Moraga.

The Mission Trail was now well known to the commander, since he had traveled it twice the year before. The first night, camp was made at the Portezuelo, near the present site of Glendale. The next night, they reached Agua Escondida, in the mountains west of Calabasas. The third day's march was a distance of nearly 40 miles, to the Santa Clara River, east of the present site of Ventura. The Santa Barbara Channel came next, and Point Concepcion, where Anza turned north, following his old trail across the Santa Rosa River and on to Mission San Luis Obispo, which the party reached after an 11 days' ride from San Gabriel.

On March 4th, the journey continued over the steep Cuesta and down the Santa Margarita River, along the Salinas, by the Paso de los Robles (Pass of the Oaks), across the Nacimiento River and the oak-lined San Antonio River, to Mission San Antonio de Padua. Here Anza was surprised by the arrival of the dashing Moraga, who had left the 12 families in charge of Sergeant Grijalva, to follow later.

From San Antonio, the trail led over the ridge and down the present Kent Canyon, traversing Portola's trail to the Salinas River. Passing down that river, the colonists passed the present site of Spreckels, reaching the Presidio of Monterey over a route which is now traversed by the modern highway, State Route 117.

The last lap of the journey on Sunday, March 10th, was made in the pouring rain. Those coming from Culiacan had traveled nearly 1,500 miles. There was cause for rejoicing, even if everyone did arrive at Monterey wet to the skin. The volleys of artillery, the firing of muskets and the special mass, presided over by five padres, was only the beginning of a gala celebration that was to last for several days.

While the colonists danced the fandango, Anza was engaged in more serious business. Father Palou and two other padres had been waiting two years at Mission Carmelo to take over their duties at the proposed new mission on the Bay of San Francisco. Palou had made a survey of the area with Rivera in 1774 and at the time was much impressed. His influence and the impatience of the colonists to become settled in their permanent home had much to do with Anza's decision to leave for the north immediately.

On the 13th of March, while writing Rivera a letter informing the latter of his intentions, the commander suffered a spell of illness. It was March 22d before

Mission of Dolores of San Francisco, A. D. 1830. The sites for both the presidio and mission were mapped by Anza in his survey of the San Francisco Bay area in 1776. Photos on this page courtesy California State Library

he was able to ride again. On the 23d, he set out with a party of 20 men: Father Font, Lieutenant Moraga, and eight soldiers from Tubac; two others who had been to the bay with Fages and Rivera went along as guides. Serra had declined to assign a friar to the expedition, fearing that by so doing, he might incur the wrath of Rivera and further hinder the establishment of the new mission.

With minor variations, the expedition followed close to the former trail blazed by Fages, Rivera and Palou. It crossed the Salinas Valley, the Gabilan Range, the San Benito Valley and the Pajaro River. Skirting the west side of the Gilroy Valley, to the pass at Coyote, Anza swung westward. He camped on San Francisco Creek (now called San Francisquito), near the lone, tall redwood tree (Palo Alto), first seen by Portola's expedition. He passed the present sites of San Mateo, Millbrae, San Bruno, Colma and Lake Merced. On March 27th, the expedition camped "on the banks of a fine lake or spring of very fine water near the mouth of the port of San Francisco."

From this campsite, on what is now the southern edge of the Presidio Reservation, Anza and Font directed the explorations that were to establish the positive positions of the Presidio and Mission of San Francisco. With each passing day, as the work of exploration continued, Anza became more enthusiastic about the future possibilities of the area. Padre Font was equally impressed. "The Port of San Francisco," he recorded, "is a marvel of nature and might well be called the harbor of harbors."

At Point Lobos, they found the remnants of the cross erected by Father Palou. Font made some sketches of Point Reyes, the Farallones and the Boca del Puerto (the Golden Gate). To the north they explored what Font called, "the white cliff which forms the end of the mouth of the port and where begins the great estuary." Here Anza set up a large cross, while Father Font ascended the green table land near by. In his diary, he made the following entry: "This beautiful country has all the conveniences desired, by land as well as by sea, with a harbor so remarkable and so spacious that in it may be established shipyards, docks and anything that may be wished. This mesa," he added, "the commander designated as the site for the new settlement and fort which were to be established on this harbor."

With further explorations, on "the Friday of Sorrows," a beautiful arroyo, with manzanita-lined banks, was selected as the site for the new mission, San Francisco de Asis.

Yet to be explored, was the "Rio de San Francisco," as the Straits of Carquinez were then called. Traveling partly over Fages' old trail as far as what is now Antioch, Anza and Font came to the conclusion that "what was called a river is not a river, but a great sea of fresh water without current, extending through that plain."

His task accomplished, Anza now decided to return to Monterey. On the return trip, the commander was a pathfinder once more. Attempting to take a short cut, he and his men spent three long difficult days making their way through the rugged mountainous country, climbing to the top of Crane Ridge near Eagle Mountain, passing towering Mount Hamilton, and eventually dropping down into Gilroy Valley.

On April 8th, they were back at Monterey. Anza had now fully resolved to return to Sonora within a few days, intrusting the actual founding of the presidio to Lieutenant Moraga.

Thus, while the Founding Fathers were laying the foundation for American independence on the Atlantic Coast, history was also being written in primitive California. On that memorable morning of June 17, 1776, 191 colonists made their way over the King's Highway from Monterey to the "white cliff" overlooking the Bay of San Francisco, to establish the Royal Presidio, by order of His Excellency, the Viceroy. Among the settlers were families destined to play an important part in the future history of California: Castro, Valencia, Bernal, Alviso, Pacheco, Sanchez, Peralta and others, whose names would one day be given to great ranchos, and later to towns, a mountain pass, and the thoroughfares of the great cities that were to rise from the shores of San Francisco Bay.

As sources of information, the author acknowledges:

Theodore H. Hittell: History of California, Vol. I., San Francisco, 1885.

Herbert Eugene Bolton: Anza's California Expeditions, in five volumes. University of California Press, Berkeley, California, 1930.

Charles Caldwell Dobie: San Francisco, a Pageant. D. Appleton-Century Company, New York, 1933.

Mildred Brooke Hoover and H. E. and E. G. Rensch: Historic Spots in California. Stanford University Press, Stanford, California, 1948.

—A. F. S.

Chapter VI

El Camino Real... Yesterday and Today

While stagecoaches rumbled over Boston's crooked streets, and white-covered Conestoga Wagons wound their way through the Pennsylvania-Dutch countryside, California listlessly existed under a civilization little removed from that of the stone age.

On the Pacific slope the average state of aboriginal culture was lowest; Indian tribes were extremely backward. They neither tilled the soil, nor possessed domestic animals. Roads were unknown, for there existed no wheeled vehicle of any kind—all transportation being done on foot, with burdens borne on human backs.

In 1769, came the California Renaissance, when Governor Don Gaspar de Portola and Father Junipero Serra reached San Diego to establish a mission settlement. For the first time in history, the horse, the mule and the ox were to stamp their indelible hoof-marks upon the soil of Alta California, marking the beginning of a new era in Western transportation.

It was the intrepid Portola himself, in his overland march in search of the Bay of Monterey, who blazed a trail through 500 miles of trackless wilderness, from San Diego to San Francisco, which with few deviations, was to become the pathway of the Padres.

During his 15 years in California, Father Serra had established nine missions: San Diego de Alcala; San Carlos Borromeo de Carmelo; San Antonio de Padua; San Gabriel Archangel; San Luis Obispo de Tolosa; San Francisco de Asis; San Juan Capistrano; Santa Clara de Asis and San Buenaventura.

With the founding of Mission Santa Inez on September 17, 1804, the nineteenth link had been forged in the mission chain. The gaps between the older establishments had now been filled in, and the spiritual occupation of the country between the Coast Range and the ocean had been accomplished. From San Diego to the Bay of San Francisco, the rough, narrow Mission Trail, known as El Camino Real, "The King's Highway," zig-zagged from the coastline inland and back again—wherever fertile valleys and abundant water prompted the Padres to select a new mission site.

No longer was the traveler forced to sleep by the roadside at night. Governors, comandantes, missionaries, soldiers and citizens could now travel conveniently from one end of El Camino Real to the other—a distance of 700 miles, enjoying the hospitality of a mission every night; for rarely did the distance between stations exceed 30 miles. At each mission station, domestic animals soon became abundant; fresh mounts could be procured without trouble or expense.

In the real sense of the word, however, "The King's Highway" could scarcely be called a road. It was a mere trail, running along the ocean shore in some places, winding through mountain passes in others, descending into canyons and traversing sun-baked valleys. For nearly all but the devout Padres, horseback was the general means of travel. Notwithstanding the fact that the animals were unshod, they were swift and hardy, making for comparatively easy and frequent transportation.

As the Mission settlements grew and the colonial population increased, great Ranchos were established over the length and breadth of Spanish Arcadia. The carreta or ox-cart, now came into use as a general means of transportation. They were primitive affairs, with their heavy wheels of solid blocks of wood, cut transversely from the butt ends of trees, and bored through the center for the huge wooden axles. In some respects the carreta might be classed as a forerunner of the covered wagon of overland fame, with its deep body arched with hoop-poles and covered with hides or cotton fabric. The crude contraption was void of springs of any kind. As it rumbled along over the unworked roads, the squeaking of its unoiled axles turning in the holes, could be heard for a mile away. The primitive vehicle was drawn by oxen, yoked by the horns. Indian drivers ran along-side, poking the awkward ani-

In the early days of travel over El Camino Real prior to 1842 this carreta was only known vehicle to travel the King's Highway. Courtesy State Library. From a drawing by Frederick Remington

mals in the sides with poles to keep them moving. On long journeys, a mattress and a few pillows added a note of comfort; but even at that, traveling was an exhaustive experience. There are recorded instances where it took as long as three months to make the trip over El Camino Real from San Francisco to San Diego by ox-cart. In the summer months, the covering over the top of the cart would frequently gather so much dust that it would sag to the point where the driver was obliged to scoop it out with a dipper.

It was now 43 years that "The Royal Road" had been in use as California's main "highway." The Spanish colonies had flourished and many of the mission establishments had become important centers of agriculture and industry. With the year 1812, came an ominous threat to Spanish security. In that year, the Russians had established themselves at Bodega, ostensibly to hunt for otter, seal and beaver. But gradually they extended their operations—buying cattle, establishing farms and fortifying a military post at Fort Ross, on the coast only 65 miles from San Francisco. Here the Russian Governor Kuskof had taken up his residence.

In the face of such bold encroachment by a foreign power, the Spanish Government and the missionaries became alarmed. Heretofore, no attempt had been made to cross the Golden Gate, or to claim the vast rich region to the north, since the Bay of San Francisco imposed an almost insuperable obstacle.

It was Father Mariano Payeras, President of the Missions, who first sounded the note of alarm, when he addressed a report upon the subject to the King of Spain in May, 1817.

Before the end of the year he began the founding of a new mission between San Francisco and the Russian settlements, to be dedicated to the Archangel San Rafael. The site was one of the most picturesque and healthful spots in all California. It was ideally situated at the foot of a high hill in a narrow, fertile valley, traversed by a small stream, emptying into the bay. To the south of Mission San Rafael, one perceived less than a mile distant, at the other side of the valley, a long steep ridge of moderate height densely covered with evergreen trees. High in the background, some five miles away, rose the purplish-blue peak of Mount Tamalpias. To the left, tule marshes spread toward the bay, and clearly discernable 30 miles distant, were the outlines of the Contra Costa Mountains, and the double-humped summit of Mount Diablo.

Although the new mission was but 12 miles in a direct line, a little west of north from the Presidio of San Francisco, it was nevertheless remote and isolated; for with such crude launches as the Californians were capable of building, it was a difficult feat to cross the channel entrance to the bay.

Moreover, Mission San Rafael was considerably smaller than any of her predecessors and offered a weak, practically defenseless barrier to the Russians. Although the latter had thus far confined their settlements solely to the Bodega Region, Padre Payeras believed they would gradually be extended. He renewed his plea for more and greater protection, only to be drowned out by the more vibrant alarm, occasioned by the progress of the revolution for independence in Mexico and South America, which ultimately brought to an end Spanish domination on the American continent.

In 1823, under Mexican sovereignty, the defenses against the Russians again became the subject of paramount consideration. It was decided that at least one and perhaps two more missions would be established east of the Russian settlement. Accordingly, it was ordered that a careful and complete reconnoissance and examination of the country to the north and northeastward of San Rafael was to be made.

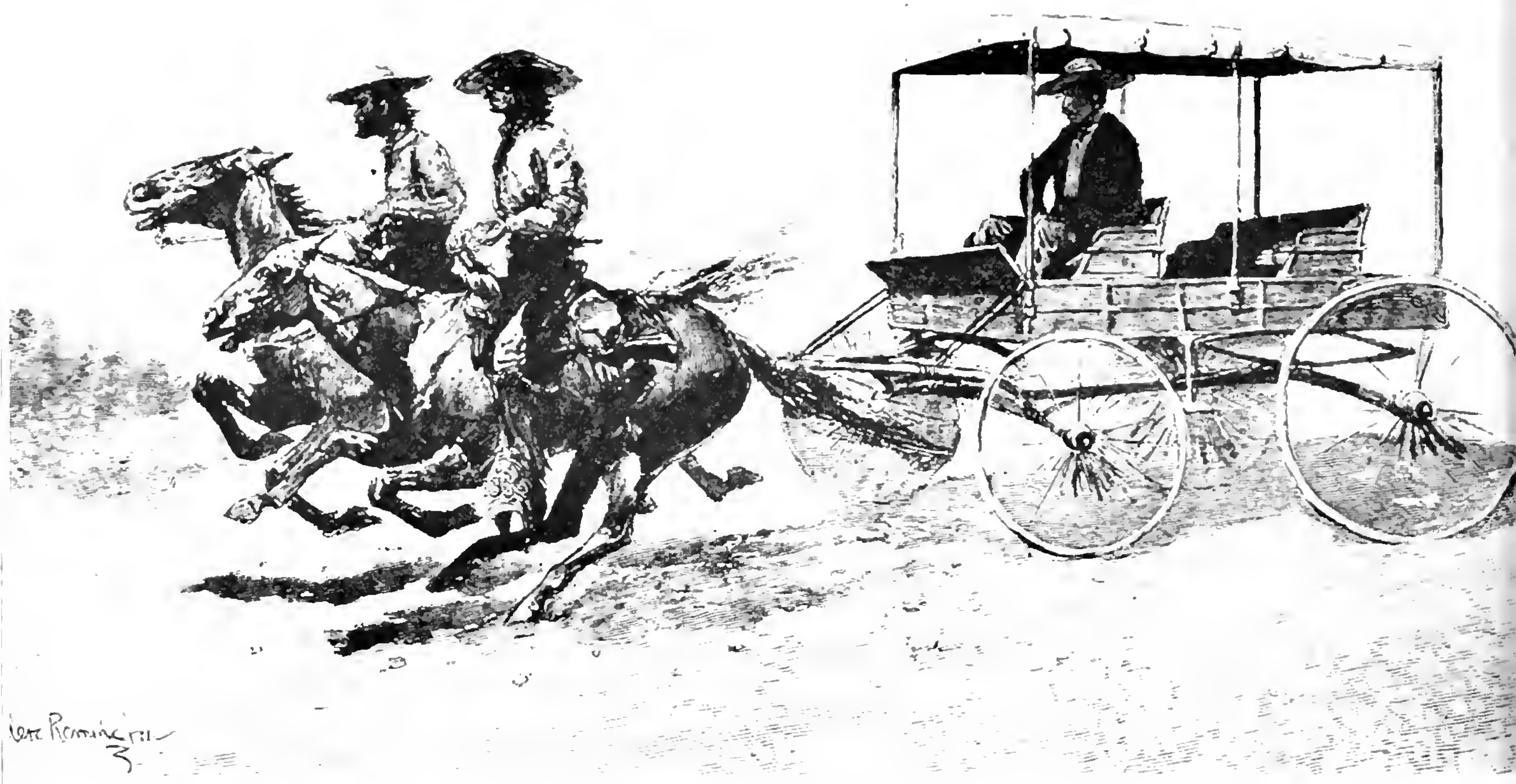
To head the exploring expedition, Don Ignacio Martinez, commander of the Presidio of San Francisco, appointed Ensign Jose Sanchez, accompanied by Padre Jose Altimira, who had come to California in 1820. The latter was to be the missionary founder of the new establishment.

On June 25th, 1823, the caravan left the Presidio of San Francisco, crossed the bay to San Rafael, and marched by way of a large Indian Village called Olompali, to the neighborhood of what is now Petaluma. Several days later, the company entered a beautiful oak-studded valley, with innumerable springs and streams. With the surrounding hills abounding in game, its marshes teeming with wild fowl, the sheltered valley had long been a paradise for the Indians. They called it "Sonoma," ("Valley of the Moon.")

Two of the reasons cited for the bestowing of this romantic appellation upon the valley of Sonoma, is that owing to the peculiar distribution of the surrounding hills, the moon may be seen to rise from behind them seven successive times in one evening. The actual shape of the valley itself may have also suggested the name. (Rider's "California.")

There was every good reason that Sonoma should have been chosen as the location for the new mission, San Francisco Solano de Sonoma, for it was conveniently located between the valleys of Petaluma and Napa. A building site was

Early day travel on U. S. 101 was rugged. This old painting shows stage coach detouring through surf at Santa Barbara. Courtesy Security Trust and Savings Bank, Los Angeles



This painting by Frederick Remington, the famous artist of the West, pictures the "Governor's Carriage," the first vehicle with spoke wheels, for description of which see text below. Courtesy University of California

selected on the easterly side of the valley, about the middle of its length north and south, with three or four miles of navigable tide water in Sonoma Creek. It was situated north of the center of San Pablo Bay and in a direct line about 23 miles a little east of north from San Rafael.

With the completion of the ceremonies for the founding of the new mission on July 4, 1823, the leaders of the expedition, Jose Sanchez and Francisco Castro, resumed their march and returned to San Francisco by way of Petaluma and San Rafael. Thus, with the establishment of the last of the 21 Franciscan stations, the Mission Trail had been extended to the shore beyond the Golden Gate.

During the next 10 years, came disturbing times of political intrigue, difficulty with the Russians and quarrels between the Mexican Government and the clergy over secularization of the missions. The fate of the Mexican colonies in the north hung in the balance. In 1834, Governor Figueroa of Monterey, acting under orders from Mexico, chose the young, diplomatic Mariano Vallejo to deal with the Russians, and to lay out a presidio and pueblo at Sonoma. With colonization of the region north of the bay, El Camino Real became the main avenue of travel between the northern settlement and Monterey, and between the latter Capital and the great ranchos of the South.

With the lifting of trade barriers formerly imposed by the Spanish authorities, American clippers had been sailing into California ports in ever-increasing numbers. Hides and tallow had now become the chief enterprise of the Californians. After the spring and fall roundups, heavily ladened ox-carts, groaning under the weight of ponderous bundles of hides, lumbered along El Camino Real, carrying their produce to the harbors of San Pedro, Monterey and San Francisco, for shipment to eastern markets.

Along the same route rode the dashing, gayly dressed caballero, astride his handsome mount; the smiling, dark-eyed señorita, who preferred the back of a fine horse to the hard-riding carreta. There was an occasional wedding procession, on its way from the rancho to the mission. There were times of fiesta, when relatives gathered from near and far, and gaudily decorated carretas loaded with happy children and a buxom señora, traveled over the narrow, dusty trail, laughing merrily and giving little heed to the roughness of the trip.

It was a happy, carefree era for all but the self-sacrificing Padres. With 1834, under the corrupt Mexican regime, secularization of the missions began in earnest. The Mission Fathers were dispossessed and one by one, the missions fell into the hands of private individuals. Most of the establishments situated off of the direct route were abandoned and soon fell into decay; vandals carried away what had been spared by the elements. In some sections, the old Mission Trail became overgrown; in other places rampaging flood waters covered it with layers of silt and debris, until only the main part of the route remained in use.

With the 1840's, California was to experience great changes. In 1842 the first vehicle with spoked wheels rambled over the rutted surface of El Camino Real, when Governor Micheltorena brought the startling innovation into the Country from Mexico. As all horses were broken only for the saddle, the Governor was compelled to attach saddle horses to the shafts, each with a rider. About 1843, a few of the wealthy rancheros began introducing calesas (carriages), and

carts with spoked wheels from the United States. Aside from these rare instances, horseback and the ox-drawn carreta were still the two common means of travel over California's principal highway.

But the romantic, leisurely days of the Dons were nearing their end. On the fourteenth of June, 1846, the sleepy little Pueblo of Sonoma was roused from her slumbers by the daring act of a band of rough frontiersmen from the Sacramento Valley. The Mexican banner flying over the plaza was torn down and replaced with a crude, muslin flag bearing the emblem of a bear and star. The Republic of California was thus proclaimed! . . . Over El Camino Real, from pueblo to pueblo, galloping riders spread the word: "The Gringos have taken Sonoma!" . . .

Events moved swiftly. On July 7, 1846, Commodore Sloat hoisted the Stars and Stripes over the Custom House at Monterey . . . The Californians and the United States were at war!

In the South, Pico and Castro rallied their forces . . . El Camino Real resounded with the beat of cavalry: . . . American forces under Fremont, it was reported, were marching on Los Angeles! . . .

Barely had the conflict ended officially, than James Marshall caught the gleam of tiny, yellow flakes in the tailrace of Sutter's sawmill at Coloma. Thus, the stage was set for one of the most thrilling chapters in California's cavalcade of transportation.

As the gold fever spread to the Southland, a motley procession began moving over El Camino Real. Within a one-week period in June, more than 1,000 men left Monterey for the mines. The coastal towns of Santa Barbara, Los Angeles and San Diego were all but depopulated. By every available means they came: Some traveled on horseback; others on foot; and a few patient souls made use of the ox-drawn carreta.

For many, however, the "King's Highway" did not lead to the proverbial Pot of Gold. Gradually the stragglers wandered back to their ranchos, to begin a new way of life under American occupation and eventual statehood.

Today, from Sonoma in the north to San Diego in the south, along the beautiful, modern Coast Highway, U. S. 101, bronze mission bells trace the route of the old "King's Highway." Though the present route may deviate from the original old Mission Trail in some places, motorists may still feel that they are traveling over ground hallowed by the sandaled feet of the immortal Padres.

As sources of information, the author acknowledges:

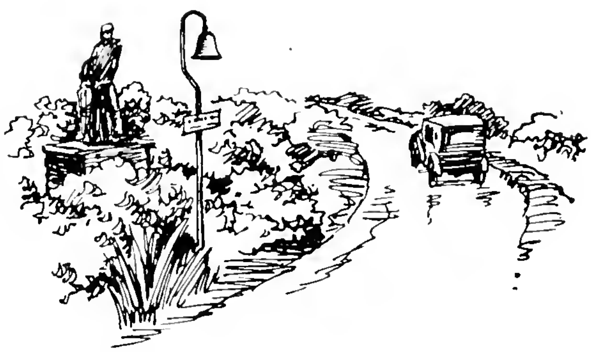
Charles Edward Chapman, Ph.D.: "A History of California, The Spanish Period." The Macmillan Company, New York, 1921.

Theodore H. Hittell, "History of California," Vol. I. San Francisco, 1885.

Nellie Van de Grift Sanchez: "Spanish Arcadia." Powell Publishing Company, Los Angeles.

Rockwell Dennis Hunt and Wm. S. Ament: "Ox-cart to Airplane." Powell Publishing Company, Los Angeles, 1929.

A. F. S.



Chapter VII

The Coming of the Fur Traders

PART I

During the uneventful days of the Spanish regime (1769 to 1822), California was virtually a world apart from the bustling young states of the Union, beyond the Missouri River. Separated by the great American deserts, the Spanish felt reasonably safe from American encroachment. To safeguard their position still further, the Spanish Government prohibited foreign ships (American and others) from entering California harbors to trade with the colonists. (There were times, however, when the practice was engaged in secretly.)

With 1822, Mexico won her independence from the Spanish Crown, and likewise laid claim to the Spanish colonies in Alta California. Under the laxity of Mexican rule, many restrictions were lifted, including the ban on foreign trade. All the way around treacherous Cape Horn, the Yankee captains now came to barter cloth from New England's mills and rum from her distilleries for hides and tallow. There were also other attractions: The coveted otter skins and the luxurious pelts of the fur seal, which had lured the Russians to establish a settlement on the northern coast of California as early as 1812.

The eyes of the young Republic were now focused on the rich, virgin land bordering the Pacific. It was obvious that a vast territory, so rich in undeveloped natural resources, so inviting to other nations, would not long remain under the control of a country so weak in military power and politically unstable as Mexico. Thus, by 1825, the United States was beginning to manifest a definite interest in California, and a vital concern for her destiny.

Between the American frontier and the Pacific, lay a wilderness of desert and mountainous terrain greater than the average Old World empire—the habitat of wild beasts and savage Indian tribes. There was no approach to California except by way of the sea. Even the first overland trail blazed by the intrepid Juan Bautista de Anza, from Sonora to San Gabriel, was no longer used by colonists from Mexico, because of the hazardous and desolate country which it traversed, and the hostility of the Yuma Indians.

For at least another generation, California might well have remained isolated and untouched by American emigration, had it not been for those daring adventurers of the outermost frontier—the rugged Rocky Mountain fur traders. Lured beyond every new horizon to hunt for the valuable fur-bearing animals, these hardy explorers, as early as 1820, had already made their way far into Texas, and up the Arkansas River into Colorado. They had penetrated into New Mexico and the upper reaches of the Colorado River.

Several large companies were formed during this period. From St. Louis, the trading caravans would assemble at the frontier post of Santa Fe, which became the main supply base; from here, hunters were sent out in all directions, regardless of the strenuous objections raised by the Spanish Government.

The fur most sought after by the Rocky Mountain trappers was that of the beaver. In the mountains, these skins sold for an average price of $5 or $6 each. So universal was their use, that they became an accepted medium of exchange throughout the West.

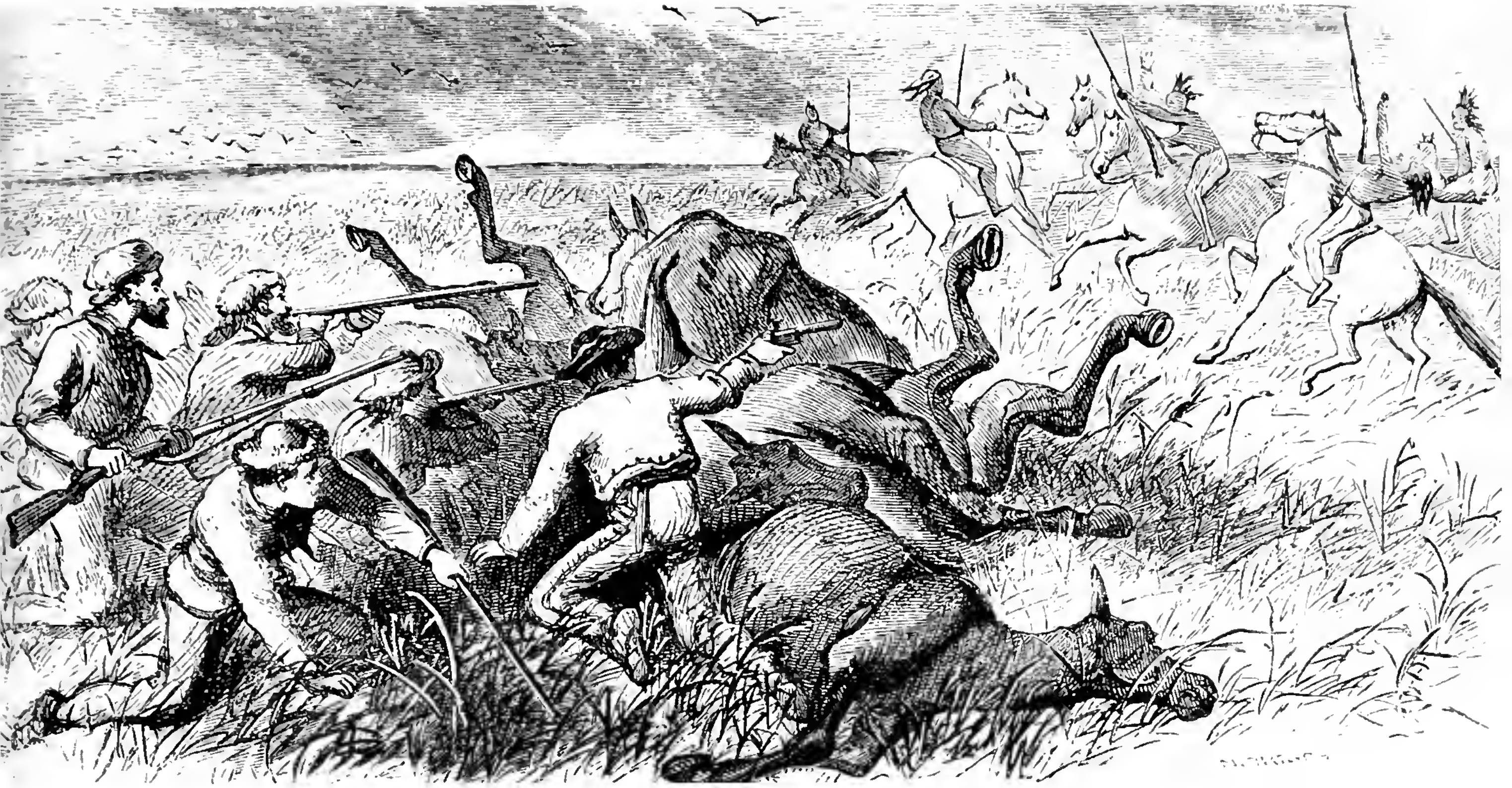
One of the most active of the early fur companies was the firm of Smith, Jackson and Sublette, who had recently taken over the interests of General William Ashley, one of the most famous fur traders of the West. In 1826, the company decided to enlarge its operations and the energetic young Jedidiah Strong Smith was selected to head an expedition to explore the country as far as California.

Among his contemporaries, the rough, uncouth men of the frontier, young Smith with his devout Christian principles, was an outstanding character, hailing from pioneer New England stock. In his boyhood he had come in contact with the fur traders of Canada and the Northwest, while employed as a clerk on one of the freight boats on the Great Lakes. At the age of 20, he went to St. Louis, then the center of the western fur trade, and engaged in trading and trapping.

As yet, no white man had ever crossed the Rockies to the Pacific by way of the Southwest. Smith believed that the vast unexplored region might be teeming with beaver, and that a great river might be found which flowed into the Pacific. It is possible that he might also have been motivated by an ambition to establish a fur-trading post on the western coast, from which furs could be shipped to China—an enterprise in which John Jacob Astor had attempted and failed in 14 years before.

During the summer of 1826, Jedidiah Smith prepared for the expedition that was to play so important a part in the ultimate development of the West. The trail which he was to blaze was virtually to shape not only the destiny of California, but of the American Nation as well. On August 22, 1826, accompanied by 15 seasoned frontiersmen, and 50 horses, Smith left the rendezvous at Great Salt Lake. He took a southwesterly course to Utah Lake, or Little Uta, as it was called by the mountain men. The expedition then followed up the Sevier River, later crossing a range of mountains to a river which Smith recorded having named the Adams, "in compliment to our President." For 12 days the party traveled down the latter stream (undoubtedly the Virgin River), finally arriving at the Colorado.

Crossing the Colorado, the trappers followed its course until they reached



In their lonely trek across the great American deserts, the fur traders were constantly harassed by savage Indian attacks.
Courtesy, California State Library

Mojave Indian Villages, presumably the present site of Needles. Smith his men were nearly destitute of es and on the verge of starvation. e was a fertile valley about five to en miles in width, where the "Am-habas" (Mojaves), raised corn, s, pumpkins and watermelons in ıdance, also a little wheat and cot- For 15 days the Americans remained ng the Mojaves, recuperating from grueling march across the desert. managed to obtain several horses the Indians, and also secured two es for the last stage of their journey California.

om here on, Smith's course is not itely clear. We do know, how-, that after a spirit-killing trek ss the desert, he finally crossed the a Madre range, either through Cajon Pass, or over the Old Mojave an Trail—a route followed by the ous priest-explorer, Father Fran- Garces, in 1776. Father Garces the first white man to cross the ernardino Mountains into the San ardino Valley; while Smith was rst American to enter California and.

In their contention that Smith traveled over the Old Mojave Indian Trail, some historians point out that recent studies of the diaries of both Garces and Smith show that the route taken by both of these explorers did not lead directly through Cajon Pass as had previously been supposed. Since Mojave Indians from the Colorado served as guides, they logically would have used the ancient Indian trail of their forefathers—leading across the desert, and up the Mojave River to its western headwaters in the San Bernardino Mountains. Approximately eight miles east of the present Cajon Pass, the Old Indian Trail descended into the San Bernardino Valley on the ridge between Devil and Cable Canyons, crossing Cajon Creek between what is now Devore and Verdemont. From this point, the trail skirted the base of the foothills to Cucamonga, passing Mission San Gabriel on its way to the sea.

In spite of the fact that Americans were forbidden in California by Mexican law, Smith and his men were hospitably received by the padres of Mission San Gabriel. The pious Fathers no doubt appreciated the fact that Smith and his chief lieutenant and diarist, Harrison G. Rogers, were men of devout Christian faith—a quality which set them apart from the general run of mountain men.

For 10 days, the leader and his party remained at San Gabriel, waiting to hear from the Mexican Governor at San Diego, to whom Smith had written upon his arrival. At length the impatient young trapper set out for San Diego to see the Governor in person, leaving his men at San Gabriel under the command of Rogers.

For nearly a month, Smith negotiated with Governor Echeandia at San Diego. Mexican law very definitely forbade foreigners from residing in California, and the Governor declined to issue passports on his own initiative. However, the present of eight choice beaver skins and the intervention of an American shipmaster, in command of a hide and tallow vessel lying at anchor in San Diego Bay, finally prompted the Governor to act in Smith's behalf.

But the suspicious Echeandia had not been as generous as it first appeared. Smith had requested permission to lead his party northward from San Gabriel, through the settled portions of Califor-

nia between the Coast Range and the ocean, to the Russian colony at Bodega. But the best he could do, was to secure the Governor's promise to allow the Americans to return unmolested over the route by which they had entered California.

Realizing that further argument was futile, Smith returned to San Gabriel on January 10, 1827. He spent several days scouting for horses at the different ranchos around Los Angeles, repaired saddles and provided supplies and equipment for the trip ahead.

On January 18th, the expedition was ready to leave, camping the first night near an Indian farmhouse four miles northeast of the mission, where they had camped before on the night of November 27th. From here they made their way eastward along the edge of the Sierra Madre Mountains until they reached Rancho San Bernardino (owned by Mission San Gabriel), near the entrance to the Cajon Pass. Smith and his men camped a short distance from the ranch, where they spent several days breaking the unruly horses and preparing for the trek through the unknown interior country—for the young leader had no intention of quitting California so soon. Mexican law might shut him out of the route along the coast, he reasoned, but in the wild region east of the mountains, there was neither Mexican law nor soldier to dispute his right of way.

Accordingly, when the expedition reached the desert entrance of Cajon Pass, it followed the Sierra Madre to the junction of the Coast Range and the Sierra Nevada—entering the southern end of the great San Joaquin Valley, either by way of Tejon Pass ("Badger"), or the Tehachapi.

On their leisurely journey down the broad, level valley, the party encountered numerous Indians, too indolent to be anything but peaceful. Finally, Smith and his men came to one of the many rivers flowing into the valley from their headwaters in the Sierra Nevada. Whether the stream which the trappers named the "Wimilche," was either the Stanislaus or the Merced River, has never been definitely determined. Smith trapped for a time, finding "a few beaver, and elk, deer and antelope in abundance." He decided to leave most of his men at the "Wimilche," and with two companions, seven horses and two mules, set out to cross the Sierra and return to the rendezvous at Great Salt Lake.

Just how and where the young explorer actually crossed the Sierra Nevada, is a matter of conjecture. In his diary he states briefly: "I found the snow so deep on Mount Joseph that I could not cross my horses, five of which starved to death. * * *" (The best authority on Smith's expeditions, Mr. Harrison C. Dale, identifies "Mount Joseph" with Mt. Stanislaus, and sets Smith's course along the middle fork of the Stanislaus River to the divide.)

Once across the formidable Sierra, the three trail-weary trappers followed the course of what was later named the Walker River, to the vicinity of Walker Lake, thence northeastwardly to Great Salt Lake, where they arrived like virtual living skeletons, with but one horse and one mule left.

In spite of the hardships endured, Smith's first trip into California had only whetted his enthusiasm to make further explorations. At the rendezvous he met his partners, Jackson and Sublette, with whom he remained for about a month. Then, with a new party of 19 men, the young trapper started out again to rejoin the hunters he had left in the mountain camp.

Following his old trail, Smith reached the Mojave Villages without incident; but here he was to meet with disaster. During the first three days, the Mojaves traded with the trappers and appeared as friendly as the year before. Then, at an opportune moment, when the company had become separted in crossing the Colorado, the savages suddenly attacked. Ten of Smith's men were killed and the remainder were forced to abandon most of their belongings and flee across the desert.

Nine and a half days later, after enduring the most terrible sufferings and hardship, the emaciated party staggered into San Gabriel. Smith obtained such supplies as he could from the kindly Father Sanchez, and leaving two of his injured men behind, hurried on to rejoin his company left at the "Wimilche" the preceding May.

Here the young explorer's problems were multiplied. The food supply was just about exhausted. Without fresh supplies, a return to Salt Lake was impossible. * * * If they applied to the Cali fornians for aid, they would be subjec to arrest. With no other recourse, Smit took two Indian guides and set out fo the Mission of San Jose, west of th Coast Range. Probably crossing th mountains by way of what is now th Pacheco Pass, he succeeded in reachin the mission in three days.

But at San Jose, young Jedidiah wa to find the head of the institution, Fathe Duran, of sterner clay than the generou Sanchez of San Gabriel. Having alread accused Smith of enticing away certai neophytes, he promptly arrested th astonished American and locked him u for three days without food. When th trapper finally obtained his release, an called on Governor Echeandia at Mon terey, the latter flew into a rage an threatened to send the habitual tre passer to Mexico as a prisoner. Finall at the intercession of several America shipmasters, the Americans were allowe to secure the necessary supplies and leav the country. To satisfy the dubious Gov ernor, Smith gave a bond for $30,000 t insure his actual departure.

Meanwhile, the men left behind the San Joaquin camp were starved ou Traveling northward, they finally mad their way to San Francisco, with the clothing in rags and badly in need food. Here Smith joined them, an through the aid of a German merchan who had recently dared to establish hin self on the California coast, were pr vided with supplies for their trek out California.

In the journey northward, the con pany passed along the "Bonadventure now the Sacramento River. About th middle of April, 1828, Smith took northwest course across the Coast Rang through what is now Trinity and Hun boldt Counties, to the coast. From her under the most painful conditions, t trapping party made its way through t wild, mountainous country into Orego where all but the leader and two of h men were annihilated by the Umpqua

It had been Smith's express intentio of making a third expedition to Cal fornia, to make an accurate geographic charting of the great interior valleys an the Sierra region. His ambition, ho ever, to present the world with an atl and history of the western country, w never realized. While on a hunting exp

on in the sandy wastes between the ansas and the Cimarron Rivers, the ng explorer was ambushed and killed the Indians, at the age of 33.

In all the annals of western trail-aking, the expeditions of Jedidiah ong Smith are among the most im-tant. Historians point out that his tribution to the development of lifornia was comparable to what Lewis and Clark expedition ac-nplished for the Pacific Northwest. t only was the modest, God-fearing ith the first white man to cross the ghty Sierra Nevada, and to traverse Pacific Slope from the Mojave Des- to Puget Sound, but his explora-ns opened up the great transcon-ental routes to California; making own to American trappers, and in rn to American homesteaders, the eat inland valleys of the San Joaquin d the Sacramento.

Probably no more fitting monument uld ever be dedicated to the memory Jedidiah Strong Smith, than the ooth, well-graded highways of to-y that pass over much of the vast ritory which he was the first to plore.

PART II

Between the time of Jedidiah Smith's ival in California on his first expedi-n, and the massacre of his men by the npquas, another party of American ppers was laboriously making its way erland to the Pacific. Leading the mpany was Sylvester Pattie and his n, James Ohio Pattie.

In the journal written by the younger ttie, posterity has been bequeathed a aphic picture of their perilous western k—one of the most thrilling episodes frontier history. The Patties too, ade their contribution to the develop-ent of the Pacific: They opened up a w overland route to the coast, and ded much to the knowledge of the eat Southwest.

Following down the Gila and the lorado River, as far as the tidewater the Gulf of California, the party ssed the desert to the Spanish settle-nts on the northern coast of Baja lifornia. At Mission Santa Catalina, y were harshly received and taken to n Diego under heavy guard, arriving re March 27, 1828.

The modern highway, U. S. 66 through the Cajon Pass—once the route of the early trappers and the Santa Fe caravans. Old road on left, new highway on right

Here they appeared before the self-same Governor Echeandia, who was nothing short of exasperated at the sight of more American trespassers. He thrust the men into a vile prison for several months, where the elder Pattie suc-cumbed to a fatal illness. Gradually, James Ohio managed to gain a conces-sion from the Governor, by using his knowledge of vaccination to save the population from extermination by a vio-lent smallpox epidemic. In 1830 he was given a passport to Mexico City and from there made his way back to his home in Kentucky.

During the years 1830 and '31, three more pioneer pack trains, composed mostly of trappers and traders from New Mexico, crossed the San Bernardino Mountains into the valley beyond. The first, a forerunner of the Santa Fe cara-vans, was led by Antonio Armijo, a New Mexican trader, who in 1830, entered the San Bernardino Valley by what he called the "San Bernardino Canyon"—(undoubtedly the present Cajon Pass). A little later that same year, came the Tennessean, Ewing Young, and his band of trappers; but unfortunately, they left no record of the trail by which they crossed the mountains. It is be-lieved, however, that they followed Smith's route into Southern California.

On his return from the Pacific Coast, Young reached Taos, New Mexico, in the summer of 1830, where he joined forces with Wm. Wolfskill, a Kentucky trapper, with several years experience in the Missouri Santa Fe-Chihuahua trade. The purpose of the expedition was to trap the interior streams of California from which Young had just returned. From Taos, Wolfskill and his party reached the Colorado by way of the San Juan, Grand and Green Rivers. They traveled south until the Grand Canyon presented an insurmountable barrier. Then a westerly course brought them to the Sevier River, from where they pro-ceeded southwesterly to the Mojave Vil-lages, and in February, 1831, traveled by way of Cajon Pass into the San Ber-nardino Valley and on to Los Angeles.

Wolfskill's trip was a noteworthy one, since his course over the mountains is clearly defined. From Santa Fe to Cali-fornia, his route approximated more closely the trail later followed by the New Mexican caravans, than did that of either Armijo or Young. It might therefore be said that it was William Wolfskill who established the famous pack-train route known as the "Old Span-ish Trail," used by the Santa Fe-Los Angeles caravans for nearly two decades.

Once each year, pack trains accom-panied by a heavy armed guard, made the round trip over the trail. California bound, the caravans carried blankets, Mexican woolen goods, silver and all sorts of American-made wares from St. Louis. On the return trip, the traders brought back mainly Chinese goods, silks and the like, obtained from trading ves-sels on the California coast. They also

drove back horses and mules for American markets.

On its way up Cajon Canyon, the old caravan trail crossed and recrossed the wash; it continued for a distance of about eight miles from the mouth of the canyon, until it reached the "Narrows," where it turned northeast. From the mouth of Cajon Canyon to Mission San Gabriel, and also from "Fork of Roads" (east of Barstow) to "Lane's Crossing" (Oro Grande), along the Mojave River, the Santa Fe Trail followed the line of the historic Old Mojave Indian Trail.

By the year 1832, there were two definitely established southern overland routes into California. First, the old trail of the Patties, running through Socorro and along the Gila to the Colorado, thence over the old Anza Trail through what is now Imperial County, to Carrizo Creek, reaching what is now San Diego County by way of the pass, later to be named for the pioneer trader, Jonathan T. Warner (Don Juan Jose Warner).

This new pass through the unknown mountain country, was first opened up by Pedro Fages in 1782, on his way back to San Gabriel from a campaign against the Yumas. The trail was rediscovered in 1825 by Santiago Arguello, while pursuing Indian horse thieves. In January, 1826, the Mexican Government sent Romualdo Pacheco, lieutenant of engineers, to investigate the route. With his approval, it was adopted as an official mail route; and that same year, Pacheco established a small garrison on the Colorado River. From that time on, the trail was used occasionally by traders from Sonora. In 1831, the former partner of Jedidiah Strong Smith, David E. Jackson, and his trading party were perhaps the first Americans to cross the mountains by way of what was later to be called Warner's Pass. Warner himself was a member of the expedition.

There was also the Old Spanish Trail, the route of the Santa Fe Caravans from Santa Fe, New Mexico to Los Angeles, by way of the Mojave Villages and the Cajon Pass; thence into the San Joaquin Valley by way of either the Tejon or the Tehachapi Pass.

In 1833-34, a third route was to be opened by Joseph Reddeford Walker, also a native of Tennessee. Walker had engaged in the Santa Fe trade for some time, and was well seasoned for this rugged experience by having previously served as sheriff of one of the frontier counties of Missouri. As a skilled mountain man, the trader had established an enviable reputation and was selected by Captain Bonneville to serve as his chief lieutenant in the latter's western expedition.

On July 24, 1833, Walker left the main command under Bonneville on the Green River and with a company of 35 or 40 men, started westward to explore the country beyond the Great Salt Lake. The exact course pursued by Walker and his men across the Sierra Nevada has never been definitely determined. One member of the expedition, George Nidever, later claimed that the route down the western slope of the Sierra, lay "through a valley between the Merced and the Tuolumi Rivers." This statement does carry considerable significance, since Walker's tombstone bears the inscription, "Camped at Yosemite, Nov. 13, 1833."

By whatever route he came, Joseph Walker claims the distinction of being the first American to blaze a trail across the Sierra Nevada directly into California from the east. His discoveries made on this and later expeditions, such as the now famous Owens River Valley, places his name high on the list of California pathfinders.

Probably more than any other group of men, the fur traders contributed to the development of the West. Spurred on by their love for adventure, they dodged death at every turn. In spite of the dangers, many lived to return to the land beyond the Missouri River, to familiarize settlers of the American frontier with the climatic virtues and the vast resources of the "Paradise" along the Pacific. After opening up the overland approaches to California, many of the mountain men became guides for the emigrant parties who were later to follow their routes. They made possible the success of government exploring expeditions such as that of the great American pathfinder, John Charles Fremont.

Today, many of the trails so laboriously blazed by these dauntless "knights" of the frontier have become smooth, luxurious avenues of travel, over which the motorist may reach his destination comfortably, within a few brief hours. The old route of the Santa Fe traders into California by way of the Mojave Indian villages (near the present site of Needles), and into the San Bernardino Valley over the Cajon Pass, is now traversed by the beautiful highway, U. S. 66. Their lonely pack trail along the edge of the Sierra Madre is followed by the famous Foothill Boulevard, so popular with the motorists of Southern California. Into the great Valley of the San Joaquin, by way of the present Tehachapi Pass, the path of the fur traders is now closely followed by U. S. Highway 466; by way of Tejon Pass and Grapevine Canyon, their route is traversed by California's principal inland highway, U. S. 99.

As sources of information, the author acknowledges:

Harrison Clifford Dale: The Ashley-Smith Explorations and the Discovery of a Central Route to the Pacific, 1820-1822. Cleveland, 1918.

Robert Glass Cleland, Ph.D.: History of California, The American Period. New York, The Macmillan Company, 1922.

Mildred Brooke Hoover and H. E. and E. G. Rensch: Historic Spots in California. Stanford University Press, Stanford, California, 1948.

—A. F. S.

Chapter VIII

Westward Roll the Wagon Trains!

PART I

During the early 1840's, California's history ran its slow, even course, with the rancheros contentedly raising cattle and trading hides and tallow to New England shipmasters in exchange for American products. They gave little thought to establishing factories of their own; but rather preferred to enjoy life, singing and dancing away the happy hours.

To the foreigners who chanced to visit the Pacific Coast, it became obvious that the stagnated state of conditions was only superficial. Beneath the surface, the forces of Destiny were actively at work: Old California, with its decadent institutions, its Old World background and traditions was fast approaching the end of its pastoral, romantic era.

The famous author, Richard Henry Dana, who came to California as a common seaman on a hide and tallow vessel, was probably one of the first to influence western emigration. In his book, "Two Years Before the Mast," he presented a graphic picture of California and its people. Upon publication in 1840, the interesting work soon found its way into virtually every hamlet and town from New York to the Missouri Valley.

There were others too, who raised their voices high in praise of California. About the time Dana's book came out, Thomas Jefferson Farnham published his popular book, "Life and Adventures in California," giving a highly exaggerated but colorful account of life in the "Utopia of the Pacific."

Lured by the promise of greater freedom from the restraints of society, wider separation from their neighbors, frontiersmen along the Missouri River began to grow restless. The hard times of Van Buren's administration further stimulated interest in California among the hard-hit settlers of the back country. Here, they reasoned, was a land of ideal climate, with abundant supply of game, natural resources and wonderful agricultural possibilities—to be had for the taking!

In Platte County, Missouri, the settlers' enthusiasm was aroused to fever pitch when a trapper named Rubidoux, recently returned from the Pacific Coast, gave an address on the marvels of California, describing it as a land of "perennial spring and boundless fertility." "* * * Innumerable herds of cattle and wild horses dot the hillsides and grassy plains," he told the land-hungry Missourians. "* * * Oranges and other fruits grow in profusion."

The result was the organization of the Western Emigration Society, designed to enlist recruits and provide a systematic program for an expedition to California. Prospective emigrants were contacted as far off as Kentucky, Indiana and Arkansas. Eventually the society circulated a pledge, binding its signers to meet the following May at Sapling Grove, in what is now eastern Kansas. Each party was required to be suitably equipped and armed, ready to start for California.

The response was overwhelming; in less than a month 500 signatures were obtained. But by spring, the enthusiasm had waned. Instead of the 500 who signed, only about 69 appeared at the rendezvous; and only one of these had signed the original pledge of the Emigrant Society. He was a trustworthy young man by the name of John Bidwell, who had recently come to Missouri from Ohio. In spite of every discouragement, young Bidwell stayed with the project, manifesting the determination of spirit that was one day to elevate him to a place of honor in the West.

It was a poorly organized group that met at Sapling Grove in May of 1841, to begin the long journey to California. Their knowledge of geography was extremely limited; moreover, John Bartleson, totally unqualified for leadership, had been chosen as the company commander by popular vote. Matters were further complicated by the presence of 15 women and children in the party.

As far as what is now Idaho, the group experienced no extraordinary hardships other than getting the wagons over a country that only once before had been traversed by a wheeled vehicle, the wagon of a fur trader. But on their journey across what is now Utah and Nevada, the emigrants endured untold suffering. On the salt plains they were bewildered and famished, going as long as 24 hours without water. At length they were forced to abandon their wagons, struggling along mostly on foot.

It was in late October, 1841, barely in advance of the first snowfalls, that the party ascended the Sierras on the north side of what is now the Walker Pass. Here they endeavored to follow a little stream (the headwaters of the Stanislaus) flowing westward instead of toward the east. But the course of the river through the mountains was too rough and precipitous for weary feet to travel. In seeking a way out of the mountain fastness, the bewildered pathfinders became entangled in gorges and canyons, many of which were more than a mile deep. Here they were forced to abandon the greater part of their animals. The few remaining horses and mules were now so weak they could scarcely travel; and as the exhausted emigrants dragged themselves down the last formidable ridge of the Sierras, fatigue had dulled their senses to the point where they were unable to realize that the great Valley of the San Joaquin lay before them. Thus, under the most grueling conditions, the Bidwell-Bartleson Party ushered in the first organized emigration into California.

Almost a contemporary was the Workman-Rowland Party, who reached California in November, 1841, over the "man-killing" overland route from New Mexico to Los Angeles by way of the Gila and the Colorado. Among the 25 or more male emigrants, recruited partly in

Missouri and partly from American residents in New Mexico, was Benjamin Davis Wilson, who was to become one of California's most distinguished pioneers, and the first mayor of Los Angeles under American rule. (Still later, he was to become the grandfather of the famous hero of World War II, General George S. Patton, Jr.)

With 1843, two more emigrant parties reached California: One from the north, and the other, the Chiles-Walker Party, entering from the east. At the start, the party consisted of approximately 30 men, besides a considerable number of women and children. Joseph B. Chiles, who commanded the expedition, had come to California with the Bidwell-Bartleson Party in 1841, and had returned to Missouri expressly to organize a new overland party. The emigrant train left Independence, Missouri, in May of 1843, far better equipped than most of the other expeditions, almost to the point of absurdity. The wagons were loaded, not only with household goods, but with heavy furniture; and even the complete equipment for the erection of a sawmill "on the Sacramento."

At Fort Hall, a small party of the men under command of Chiles, turned northward to Fort Boise for supplies, while the main part, led by the former trapper, Joseph R. Walker, took a more southerly course. From Fort Hall they drove their heavily ladened ox wagons to the Humboldt River, following the stream to its sink in western Nevada. Then, turning south, the party came to Walker Lake. From here on, their course south took them through difficult mountainous country and across semidesert wastes, until they reached the alkaline body of water, now known as Mono Lake.

Slowly the caravan laboriously made its way over a succession of sandy ridges to the crest of a pine-clad ridge. Here flagging spirits were bolstered by the sight of a river, clear as crystal, looping its way through a pleasant green valley, which sloped gently to the south. Herds of elk, deer and antelope grazed peacefully on the lush vegetation covering the valley floor. To the left rose a range of barren, brown-gray mountains; while on the right, stood the majestic wall of the Sierra Nevada. At first the trip was pleasant through the valley, which two years later, the great American pathfinder, John Charles Fremont was to name, "Owens," in honor of Richard Owens, one of his own men. But as the emigrant train reached the lower end of the valley, travel became more difficult. The oxen were scarcely able to pull the heavy, overloaded wagons through the wide, sandy stretches; in other places they were forced to make many tedious detours around the boulder-strewn base of the mountains. Finally, near the lake which was later named Owens Lake, the emigrants were forced to abandon their wagons and load what goods they could upon the backs of the horses and oxen. The heavy mill machinery was reluctantly buried in the sand, where 20 years later it was unearthed by a mystified group of prospectors.

After several days' hard travel from the lake, Walker and his party entered the pass through which the trapper had led the Bonneville Company out of the San Joaquin in 1834. Through this broad gateway, the Sierras were successfully crossed without the hindrance of snow or other difficulty; but on the California side of the range, the emigrants were to undergo intense suffering. From the western outlet of Walker Pass (situated about 60 miles northeast of the present City of Bakersfield), in trying to reach the western side of the San Joaquin Valley, the party became trapped in a region of hot, choking alkali wastes. For nearly a hundred miles there was practically no water. By the time they found their way out and reached one of the tributaries of the Salinas River, they were nearly half-dead from exhaustion. But with a few weeks of recuperation in a pleasant little valley which Walker had previously discovered, the emigrants were able to complete the last lap of their long journey, reaching the Gilroy Rancho, in what is now Monterey County, in January of 1844. Today their arduous trail past Mono Lake and through the Owens River Valley is closely followed by U. S. Highway 395; and over Walker Pass by State Sign Route 178.

By the time hostilities broke out between California and the United States, in July of 1846, much had been accurately learned regarding the climate, geography and natural resources of California. The United States Governmer had taken a hand in making the provinc better known to the American people b sending out several exploring exped tions: One, a naval squadron under th command of Lieutenant Charles Wilke reached the Pacific Coast in 1841; ar other in 1843, under the direction of th chief of the Corps of Topographical En gineers of the United States Army headed by Lieutenant John Charle Fremont.

A third exploring expedition beyon the Rocky Mountains, to discover th most feasible route from the Mississip to the Pacific, brought the famous path finder to California for the second tim in 1845, just when relations betwee California and the United States wer becoming strained. In the subsequer conflict, which began on July 7, 184 when Commodore Sloat raised the Sta and Stripes over the Custom House Monterey, Fremont played an importar role.

With the Treaty of Guadalupe H dalgo, signed February 2, 1848, Califo nia formally became a part of the Unite States. Two weeks before, by a strang act of fate, a few golden flakes had bee discovered in the tail race of Sutter's sav mill at Coloma. Once again shipmaste were to carry word of the newly acquire territory to the eager inhabitants of th Atlantic seaboard. This time, it was r mere account of climatic charms ar fertile valleys, where men might car a homestead in the wilderness. It w exciting news of a fabulous hidden trea ure, suddenly yielded by Mother Natur news that set men's souls on fire ar started one of the mightiest migratio the world has ever known.

During the winter of 1848, the ove land routes were naturally closed travel, and the first great influx came sea. But by spring of 1849, the wag trains began to roll! Within a thr weeks' period alone, nearly 18,000 em grants crossed the Missouri River. Ov the parched plains and the great Ame can deserts, the endless train of whi covered wagons (and vehicles of nea all types and descriptions), the herds animals, and the migrating mass humanity—men, women and children resembled a virtual nation on the marc

PART II

Emigrant Trails of '49 (The Southern Route)

In addition to the heavily traveled northern routes into California, by way of the Humboldt and Truckee Rivers, and from Oregon by way of the Willamette and the Shasta route, emigrants also poured in from the south. The old Spanish Trail, the historic route of the trading caravans from St. Louis to Santa Fe, became a well beaten path. From Santa Fe westward there was a choice of two routes: One, the old Pattie Trail, by way of Socorro, thence along the Gila to the Colorado, crossing to the coast by way of the pass named for the Connecticut Yankee, Jonathan T. Warner. The trader had come to California in 1831 with the David E. Jackson party, the first Americans to pass over this route.

The land surrounding the famous hot springs, which also bear Warner's name, comprised about 49,000 acres, and came under the joint control of Missions San Diego and San Luis Rey. After secularization of the missions, and the confiscation of their lands in 1836, the entire valley, known as the Valle de San Jose, discovered and named by the Spaniards in August, 1795, was granted to Silvestre de la Portilla. For some reason, the grant lapsed; and Jonathan Trumbull Warner (Juan Jose Warner), applied for title to the land in 1844.

Don Juan was a liberal host and dispensed generous hospitality at his great estate known as Warner's Ranch. In 1846 the site became a camping place for Stephen W. Kearny's regiment and other divisions of the Army of the West. The Mormon Battalion passed that way in 1847; and with 1849 Warner's Ranch became a haven for the gold-seekers who entered California over the old Emigrant Trail, which traversed Anza's old route across the Colorado Desert from Yuma. (Today, State Sign Route 79 passes close to the historic ranch.)

Another of the southern overland routes, followed Wolfskill's trail of the early thirties, and the route of the old Santa Fe-Los Angeles caravans. This trail reached the Colorado by way of the Grand, Green, Sevier and the Virgin Rivers. From the Colorado, near the present site of Needles, the route continued on to Southern California by way of the Cajon Pass. The latter route had been well charted by the Mormons in 1847, when Captain Jefferson Hunt of the Mormon Battalion left California by way of the square, box-like canyon called the Cajon.

Monument on the Old Emigrant Trail in San Bernardino County, erected by the Daughters of the American Revolution, in honor of the mothers of covered-wagon days, who passed over this part of the historic road

East of the Cajon, the trail turned northward into the Valley of the San Joaquin by either the old Tehachapi Pass or the Tejon. (The old trail ran by way of Oak Creek Pass and Tehachapi Creek. Originally, the latter pass was called the Tehachapi; with the building of the railroad in 1876, the name was transferred to the present Tehachapi Pass.)

Still another emigrant trail was the route down the Owens River Valley, through what is now western Inyo County (U. S. 395). Over Walker Pass (State Sign Route 179), the trail led to the South Fork of the Kern River, named by Lieutenant John C. Fremont in 1845, for Edward Kern, a member of his expedition who mapped the river.

At Isabella, the junction of the South and North Forks of the Kern River, the trail divided. One branch went south by way of Bodfish, Havilah and Walker's Basin; thence west by several routes to the ferry on the Kern River (Gordon's Ferry), about five miles northeast of the present City of Bakersfield. The other branch of the trail crossed the Kern River near Isabella, passed over the Greenhorn Mountains, either to Poso Flat, or to Linn's Valley (near Glennville), and then turned north to the White River and what is now Visalia.

The Manly-Bennett-Arcane Party rescued from the silent Valley of Death
From Manly's book: Death Valley in '49
Courtesy, California State Library

Even with the overland routes well established, many emigrant parties met with disaster en route to California. In their fever to reach the gold fields, some attempted to blaze new trails, seeking a shorter route. One of the greatest of such tragedies occurred in the devastated region lying east of Owens River, which because of the suffering of the emigrants trapped there, acquired the grim appellation of Death Valley. Two companies are known to have wandered off the beaten path into the long, sunken desert surrounded by high mountains (the lowest spot in the Western Hemisphere, 267 feet below sea level). A graphic account of the tragedy enacted there is given in the book, "Death Valley in '49," by William Lewis Manly, a member of the first emigrant party.

Manly and his followers joined a wagon train near Salt Lake, supposedly following the regular Salt Lake-Los Angeles route. But instead of pursuing the trail all the way to the Mojave villages, part of the train led by Captain Smith, turned off near Mountain Meadows, with the intention of traveling west to the San Joaquin. Manly, together with a friend named Bennett who commanded several wagons, and another named Rogers, followed the Smith party.

Several of the company turned back to the regular Los Angeles trail even before reaching the desert. The remainder separated into two groups. One division calling itself the "Jayhawkers," was composed almost entirely of young, unmarried men, who had started from Galesburg, Illinois, in the spring of 1849. In their rush to reach the gold fields, the adventurers branched out on their own, leaving Manly and the men with women and children to make their own way alone.

On Christmas Day Manly and his party entered "the Valley of Burning Silence," and set up camp beside what was later called Furnace Creek. It was imperative that relief be secured immediately, or the entire party would perish in the sandy wastes. Manly and Rogers volunteered to cross the mountains to seek help, while the rest of the party, consisting of 13 adults and seven children, remained at the camp.

On their mission of mercy, the two intrepid heroes endured the most dreadful privations; but at last succeeded in reaching the little settlement of San Fernando, a few miles north of Los Angeles. Obtaining supplies and a few pack mules, they started back to rescue their friends.

A few miles from camp the ghastly sight of a member of the party lying dead upon the sand, his empty canteen by his side, increased the men's anxiety for the safety of those left behind for nearly 26 days—starving and thirsting in the deathlike silence of the lonely region. Within sight of the camp, they noticed that se[…] eral of the wagons were missing. The[…] was no sign of life about and it w[…] doubtful whether any of the party st[…] survived. Manly fired his gun and a m[…] crawled feebly from beneath one of t[…] wagons. For the moment he seemed t[…] weak to comprehend that the messeng[…] had returned. Then, suddenly, with […] newed life, he threw his arms in the […] and cried out: "The boys have come[…] the boys have come!"

Only the Bennett and Arcane famil[…] remained in camp. Most of those w[…] had straggled on alone were never hea[…] from again. As for the adventurous Ja[…] hawkers, some historians maintain th[…] nine of their number perished to the ea[…] of Death Valley; and four more di[…] after leaving it, but while still in t[…] desert.

Manly's own words can best descri[…] the moment of departure from the gri[…] sunken valley. "We took off our hats," […] wrote, "and then overlooking the sce[…] of so much trial, suffering and dea[…] spoke the thought uppermost in o[…] minds, saying: 'Goodbye, Death Valley[…]

Once released from the tortuo[…] region, the forlorn party followed alo[…] the eastern slope of the Sierra, pa[…] Walker Pass, through Red Rock Canyo[…] into the Mojave Desert and on to t[…] San Gabriel Mountains. There th[…] finally passed through Soledad Cany[…]

ess than 10 years after the emigrant trains fought their way across the desert wastes, Uncle Sam tried the novel experiment of a "camel express." 'he huge beasts were used to carry supplies to the different army posts and to haul materials for the construction of military roads.—Drawing by Edward Vischer, courtesy University of California

nd over Newhall Pass into the San 'ernando Valley.

Others who came in the Gold Rush :ra and in the years immediately follow- ıg, likewise contributed materially ›ward laying the foundation for Cali- ›rnia's vast system of highways, re- arded as one of the best in the Nation ›day.

The Mormon occupation of what is ow San Bernardino County in 1851, ıd the subsequent founding of the City San Bernardino by those hardy, indus- ious pioneers, not only marks a mile- one in the county's history, but in the history of some of Southern California's most important highways. The fine, wide streets of the City of San Bernardino, the numerous roads leading to the saw- mills erected in the mountain areas, and the opening up of the present Foothill Boulevard as far as Cucamonga are all credited to the Mormon settlers.

In reviewing California's past, one finds a history fascinating and dynamic, tinted with romance and stained with pathos; sprinkled with names long since stricken from the roll, but never to be forgotten: The names of the immortal pathfinders and the heroic pioneer mothers, who braved the hazards of the Overland Trail to lay the foundation for a new and mighty Empire on the shores of the Pacific.

As sources of information, the author acknowledges:

1. William Lewis Manly: Death Valley in '49. San Jose, 1894.
2. Robert Glass Cleland: History of California, The American Period. New York, The Macmillan Company, 1922.
3. Joseph J. Hill: History of Warner's Ranch. Los Angeles, 1927.
4. Hero Eugene Rensch and Ethel Grace Rensch: Historic Spots in California, The Southern Counties. Stanford University Press, Stanford, California, 1932.

A. F. S.

house, comparatively close to both the Purisima and Santa Ynez Missions.

Having reached middle age, Don Julian was a respected and influential figure in the community. Allied to the Californians by reason of his marriage into one of the prominent Spanish families, he had thus far taken no part in the contest for California, now looming ominously on the horizon. He might also have held aloof from aiding the Americans by reason of allegiance to his native England, whose warships hovered dangerously close to the California Coast.

For two weeks Fremont and his men had camped under the spreading oaks on Foxen's ranch, about two miles from the latter's home. The party had been well supplied with provisions by the generous Englishman, who provided Fremont with a quantity of flour and bran, also 40 head of cattle. The bran was mixed with water in a pan and drunk by the famished Indians; while the soldiers killed the cattle, and after filling their hungry stomachs, jerked the remainder of the meat.

During his stay on Tinaquaic Rancho, Fremont frequently rode down to the Foxen home, where he and Don Julian enjoyed many friendly chats together. One evening, approaching the third week of his encampment on the property, the dashing lieutenant, as usual, tied his white horse to a sturdy oak timber, standing upright in the ground in front of the hospitable ranch house. In the course of the evening's conversation with Don Julian, the lieutenant confided to the latter that he was planning to leave shortly for Santa Barbara.

"By way of Gaviota Pass we can be in Santa Barbara in two days," he said confidently.

Don Julian was thoughtful—visibly disturbed. Finally he brought himself to speak the thing that had been haunting his mind for days.

"You must go back and try to reach Santa Barbara by some other course," he warned Fremont. "The Californians are laying for you in Gaviota!"

"But that's impossible!" Fremont asserted vigorously. "A delay would prevent me from meeting Stockton in the San Fernando Valley. It might change the whole course of the war!"

Then, knowing full well the vengeance that would be wreaked upon him by the infuriated Californians, Don Julian disclosed to the discouraged Fremont, the plan of the enemy. Gumesindo Flores, comandante at Santa Barbara and Augustin Janssens of Santa Ynez had assembled every able-bodied man in the district, several hundred in number. They were waiting for Fremont's battalion to move through the narrow, sheer-walled Gaviota Pass, where they had planned to trap the commander and his men and annihilate them.

The servants and everyone at the rancho were in sympathy with the plan, Foxen stated, with exception of his wife. For days the unhappy Senora had pleaded with her husband to warn the American officer, so the slaughter might be averted.

On the high peaks of the Gaviota Pass, Don Julian revealed, the Californians had been standing sentinel, marking every move of Fremont and his men. They lined the "Pass of the Gulls" for more than a mile, he went on to explain, watching for the company to pass the spot where it would be hemmed in between two sheer walls of rock, in a canyon so narrow that a wagon could scarcely pass between the high perpendicular cliffs. Here, upon the advancing "Gringo" force laboring through the narrow defile, the Californians would hurl down tons of rock, loosened by blasts of gunpowder. Men and horses would be crushed like ants; the pass would be effectively blocked. Those who survived the barrage of rock would be picked off by rifle bullets.

While Foxen spoke, Fremont's face was tense. "Is there no other way of reaching Santa Barbara from here?" he queried anxiously.

Don Julian thought a moment. "There's the San Marcos Pass," he suggested hesitatingly. "But it's only a wild, narrow horse trail; I'm afraid you'd never get your wagons through."

"We'll have to try it!" Fremont uttered with determination. "There's no other way!"

Meanwhile in the Gaviota Pass Region, nights were given over to feasting and reveling—so confident were the Californians of success. When Fremont broke camp, the sentinels on the cliffs, assuming that the battalion was headed for Gaviota, galloped off to advise Janssens. But their wait was a long one; for the battalion led by Don Julian and his 17-year-old son Guillermo, turned abruptly to the left after emerging from the mouth of Foxen Canyon, instead of continuing across the valley of the Santa Ynez.

Past the site of the present town of Los Olivos Foxen led the party, following the Santa Ynez River toward the wall of the San Rafael Mountains in the east, to begin the assault of the wild, dangerous San Marcos Pass. A southeasterly storm was raging while Fremont and his company labored to open a path for the wagons. Foxen and his son worked shoulder to shoulder with the men, using axes and crowbars to hack and chisel the semblance of a road over the perilous heights. Men worked until they fell with exhaustion; several died from exposure. Heavily-laden pack animals slid over the rocks and fell down the precipices, blinded by the driving rain. Three hundred horses lay dead along the wayside—victims of the terrific struggle with the forces of nature.

On Christmas Day, 1846, the summit was reached. Don Julian now returned to his rancho, leaving Guillermo to guide the American pathfinder and his men down the precipitous face of the mountain to the plain below. The descent was equally laborious: More than a hundred horses were lost. Artillery and baggage were strewed along the way as on the trail of a departed enemy.

But the bright, sunny morning of December 27th brought new hope and strength to the weary, footsore battalion. The men gathered themselves into an appearance of order and made their way into Santa Barbara. Just as Foxen had predicted, almost to a man the male population was assembled in the Gaviota Pass awaiting Fremont's company; the rest of the townspeople were attending mass. Thus, thanks to the courage and ingenuity of two great men—Foxen and Fremont—the Stars and Stripes were raised over Santa Barbara without bloodshed.

The dramatized narrative is based on facts and information gleaned from the following sources:

Michael J. Phillips: History of Santa Barbara County. Clarke Publishing Company, Los Angeles, 1927.

Laurance L. Hill: Historical pamphlet Santa Barbara. Security-First National Bank Los Angeles, 1930.

Kenneth C. Adams: California Highways and Public Works, August, 1936.—A. F. S.

Chapter X

The Butterfield Overland Mail

WITH STATEHOOD in 1850 the people of California were no longer satisfied with the monthly mail service between the East and the West conducted by the Pacific Mail Steamship Company. Pleas for a new overland service began to appear daily in the newspapers. With the same purpose in mind, the State's first senators, William M. Gwin and John C. Fremont presented resolutions and petitions in Congress.

Finally in April of 1850, Congressman R. H. Stanton championed the cause of he isolated Californians. In his report on ost offices and post roads, the congressnan recommended that something be lone immediately to relieve the critical ituation.

Slowly and methodically the Federal Government took the first feeble steps to stablish overland communication, when n April 25, 1851, a contract was granted o Absalom Woodward and George Chorenning to carry the mails monthly beween Sacramento and Salt Lake City, vith a single team making the entire rip. No provision was made for pasenger service.

In the South, the communication serve was equally deplorable. Although the acific Mail Steamship Company drew n annual government subsidy of $700,00 for carrying a monthly mail between Jew York and San Francisco, Southern alifornia suffered the most exasperating elays in receiving eastern mail. Letters om New York were sometimes seven r eight months reaching Los Angeles, ue to the inefficiency of the Pacific lail service.

What the Californians were really riving for was to get Congress to pass Pacific Railroad Act. In 1856 four such lls were introduced, all of which failed pass. Finally, in February, 1857, a bill lating to improved western communicaon again came to the congressional oor, only to meet with disagreements between the House and the Senate. After a compromise, however, on March 3, 1857, Congress finally passed the measure, and the Post Office Appropriations Bill was subsequently approved by the President.

Under the terms of the act, the Postmaster General was authorized "to contract for the conveyance of the entire letter mail from such point on the Mississippi River as the contractors may select, to San Francisco, in the State of California." The measure further stipulated "that the contract shall require the service to be performed with good four-horse coaches or spring wagons, suitable for the conveyance of passengers as well as the safety and security of the mails."

While the question was being decided as to who would be given the contract and what route the stages would follow, the already existing mail line over the old Santa Fe Trail was extended to California by United States Postmaster General Aaron V. Brown. In June of 1857 a contract was awarded to James Birch, a well-known stageman of the West, and former President of the California Stage Company, to operate what was officially called the San Antonio and San Diego Mail.

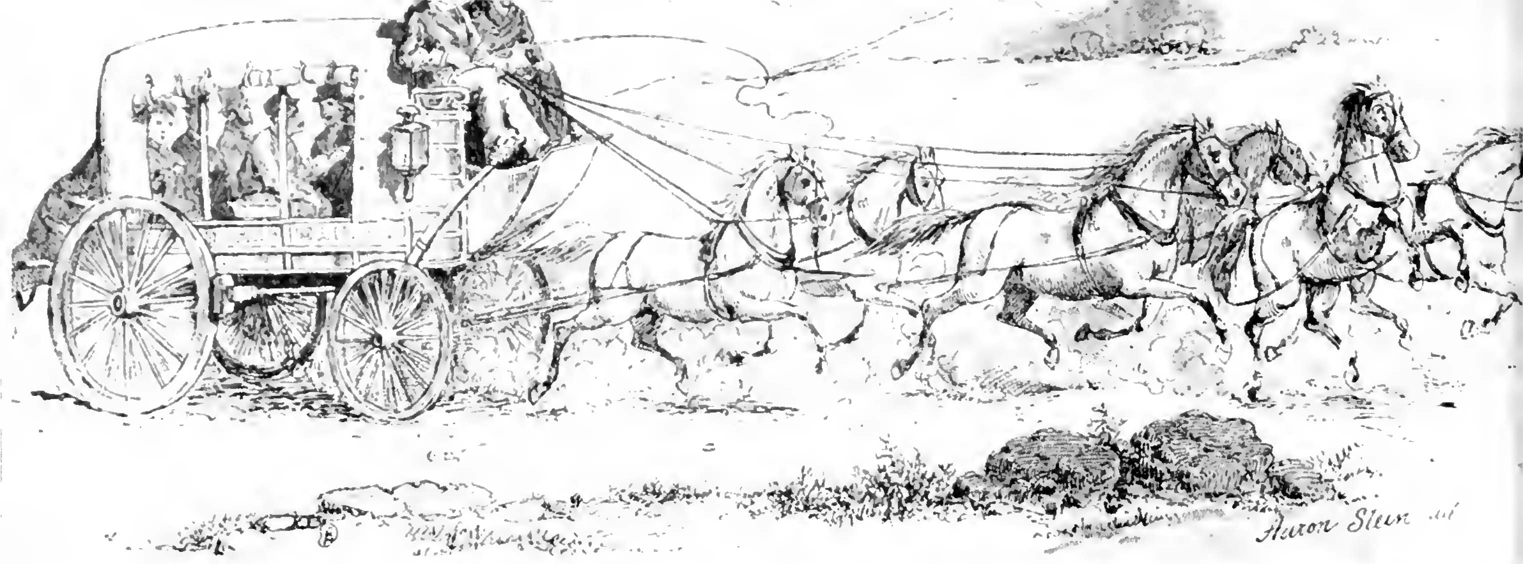
The new line would provide semi-monthly service on a 30-day schedule between San Antonio and San Diego, with Birch receiving $150,000 per year in compensation from the Government. In less than 30 days, Birch had fulfilled the terms of his contract by dispatching the first mail west from San Antonio. Mules instead of horses were used to pull the coaches. Because of this fact, and also since pack mules were used to transport the mails over the final 180-mile stretch from Fort Yuma to San Diego, Birch's new line was derisively dubbed, the "Jackass Mail." Even though the efficiency of the line was much criticized, it managed to make the 1,476-mile trip in less time than the contract called for. While it did relieve the communication problem to some degree, it was still far from adequate to meet the demands of the rapidly growing West.

Meanwhile in Washington, bids were coming in right and left for the contract to operate the new overland mail service voted by Congress. Chief among the bidders was John Butterfield of New York, an associate of William G. Fargo and William B. Dinsmore. Butterfield was a self-made man, who had risen from a common stage driver to become the founder of the American Express Company in 1850. As a fellow New Yorker, he was a personal friend of President Buchanan; and it was undoubtedly due to the President's influence that Butterfield received the contract from Postmaster General Brown.

At first the route selected by Brown caused much controversy, as when put into operation it would be the longest mail stage route in the history of the world. In spite of Brown's contention that it would be found safe and usable during every season of the year, there were many who scoffed, branding it as a "speculation scheme."

On the lower Mississippi River, the route would have two eastern terminals —one to be St. Louis, the other Memphis—which happened to be the Postmaster General's home town. At Fort Smith, Arkansas, the routes from the two places would converge, and continue on together from there. The western portion would pass through Indian Territory to Colbert's Ferry, Texas, on the Red River; thence in a southwesterly direction across Texas to Franklin, and westward across the southern part of New Mexico Territory to Fort Yuma, California, on the Colorado River.

Within the State of California, the Butterfield Trail was to dip southward from Fort Yuma into Mexico;



THE CALIFORNIA OVERLAND STAGE—From A. L. Stimson's History of the Express Business. Courtesy, Stanford University Press

it would reenter the State near the New River (in what is now southern Imperial County), and proceed to Los Angeles by way of Warner's Ranch. It would not lead through the San Bernardino Valley, however, after leaving Warner's Ranch; but would reach Los Angeles by way of Temecula, Sierra Rancho and Chino. From Los Angeles the trail was mapped to run north through the San Joaquin Valley to Fresno City (approximately over what is now U. S. Highway 99); thence over the Pacheco Pass (State Sign Route 152), and through the towns of Gilroy and San Jose, terminating at San Francisco.

There was little time to lose, since the service would begin on September 16, 1858, one year after the contract was signed, and many obstacles were yet to be overcome. Butterfield drew heavily on his years of experience in the communication service and set to work to organize the new line. He arranged for rail transportation from St. Louis to Tipton, the western rail terminal in Missouri. From Tipton to San Francisco, the trip would be made entirely by horse-drawn stages. One hundred and thirty-nine stage stations were erected, averaging about 18 miles apart. The buildings were hastily thrown up, constructed of any type of material the locality afforded; some were of lumber, others of stone and adobe. In the desert areas, wells were sunken at tremendous cost and effort; in places without water, it was hauled in.

Next the veteran stageman turned his attention to the type of coaches to be used. On rough, mountainous stretches he selected the "Celerity" or mud wagon. Concords were much preferred, but Troy coaches would have to serve for the present. Mules and horses were acquired by the hundreds—wild mustangs rounded up on the range and broken for service. Hiring the various types of personnel was another major task: Division managers, station attendants, hostlers, stage drivers and shotgun messengers. To his drivers, all specially picked men, John Butterfield gave the following admonition: "Remember, boys, nothing on God's earth must stop the United States mail!"

As the months of 1858 flew by, Butterfield and his associates worked feverishly to meet the September 16th deadline. So efficiently had they managed the project, that the eastbound stage left San Francisco one day ahead of schedule; and on the morning of the 16th, as stipulated in the contract, the first mail marked "Per Overland Mail" left St. Louis for the West. There were only two bags of mail and the only through passenger was young Waterman L. Ormsby, a special correspondent for the New York *Herald*.

In a series of newspaper articles written about the trip, Ormsby described the coach as sturdy, with the body resting on thorough-braces. The three seats could be let down to form one bed, accommodating four to ten people. Travel continued day and night, with brief stops to change the four-horse teams and for meals. Drivers were changed every two or three hundred miles. It took some time to get accustomed to the bumping and jolting over the rough road, the rocks and the log bridges, Ormsby wrote; bu[t] by the end of the third day he was "quit[e] oblivious" to the discomfort of stagecoac[h] travel.

Once across the Colorado River an[d] into California, the Butterfield rout[e] traversed approximately the same ol[d] desert trail across Imperial Valley tha[t] was first opened by Juan Bautista d[e] Anza in 1774, and later followed b[y] hundreds of emigrant wagons. Warre[n] F. Hall, a veteran stageman, endowe[d] with much energy and initiative, was i[n] the driver's seat as the first overland ma[il] stage arrived at the Indian Wells Statio[n] on Tuesday, October 5, 1858. From ther[e] the route continued northwest over th[e] desert wastes for 16 miles to Hall's Wel[l]. Not until Carrizo Creek was reached, 1[?] miles northwest of Hall's Well, did th[e] weary traveler glimpse the first vestige o[f] vegetation.

From Carrizo Creek the stage heade[d] northwest through the heavy sand fo[r] Palm Springs, thence to Vallecito (Littl[e] Valley) in what is now San Dieg[o] County—a veritable oasis in the desert. Eighteen miles northwest of Vallecito was the San Felipe adobe station, situated close to the road, on the west ban[k] of San Felipe Creek (about 300 yard[s] north of the present Julian-Kane Spring[s] road, State Sign Route 78).

At Warner's Ranch, Ormsby had th[e] feeling of being back in civilizatio[n]. Chino Ranch came next and then "Th[e] City of the Angels," with its 6,000 inhabitants, most of whom were Mexican[s] and Indians. The next stop was Cahuenga, 12 miles northwest of Los Angeles, the junction point of the coast and in

land routes. (The site is an historic one, as it was at old Cahuenga Rancho that the treaty was signed by General Andres Pico and Lieutenant Colonel John C. Fremont, ending the War with Mexico.)

Fourteen miles northwest of Cahuenga, the abandoned Mission of San Fernando, used as a Butterfield station, provided Ormsby with a glimpse into the romantic days of the Spanish regime. Then came the San Fernando Pass, which had long presented a formidable barrier to all who crossed it, including the Butterfield Overland Stage. From the summit of the pass, the mail route wound down the canyon through what is now Oak Glen, much as does the present highway, U. S. 99.

Ascending Tejon Pass, the stage made its next important stop at Fort Tejon, the military post established in 1854, for the purpose of guarding the pass and controlling the Indians. From the fort, the Butterfield route followed a winding course down the steep grade through the Canada de las Uvas (Grapevine Canyon), crossing and recrossing the creek as it made the descent for six miles into the southern extension of the great basin of the San Joaquin Valley. At the various small stations the driver stopped just long enough to water his horses and at some places teams were changed.

Visalia was the next important stop. The little town of 500 inhabitants was the largest on the inland route between Los Angeles and Gilroy, a distance of 300 miles. The excited townspeople were on hand to greet the arrival of the first westbound overland stage as it swung into the station at exactly 11 o'clock on the night of October 8th. Over a foaming glass of lager the correspondent enjoyed a chat with several fellow New Yorkers who had settled in the vicinity. Then precisely at 11.50 that same night, the mail coach was on its way again, rolling swiftly along toward the little settlement of Fresno City (then located on the east bank of Fresno Slough, a mile and a half north of the present town of Tranquillity).

From Fresno City to the next stop at Firebaugh's Ferry, a distance of 19 miles, the driver traveled at breakneck speed. Over the Pacheco Pass to Gilroy, on the night of October 9, 1858, Ormsby experienced the wildest ride of his young

The old adobe stage station at Warner's Ranch in San Diego County. From the book, Romance of the Highways of California, by Commander A. W. Scott

life, as he sat in the box beside the driver "Tate" Kinyon.

"Why don't you put on the brake?" he queried anxiously, as the stage, rocking and swaying, rumbled down the steepest grade at top speed.

The driver rolled a wad of tobacco in his mouth and replied calmly: "You got 'a keep the wheels turnin', or they'll slide!"

By the time the stage reached Gilroy, late on the night of October 9th, it had actually made 12 miles in one hour and five minutes. By 1 p.m. it was in San Jose, driving the last lap of the trip in the darkest hours of the night. At sunrise on Sunday morning, October 10, 1858 (over what is now the Coast Highway, U. S. 101), the first westbound overland stage was heading up the Peninsula for San Francisco. At exactly 7.30 a.m., just 23 days, twenty-three hours and a half since it set out from St. Louis, the stage of the great Butterfield Overland Mail was clattering over San Francisco's streets on its way to the station at Portsmouth Square. The driver sounded a shrill blast on his horn to announce to the townspeople the arrival of the first United States Mail over the overland route.

All through 1859 and 1860, the Butterfield line continued to grow in public favor. Over the lonely prairies and the silent deserts, its drivers and passengers resisted Indian attacks, weathered cloudbursts and sandstorms. Travelers accepted the rough and tumble of stagecoach travel without complaint; and nearly every man complied with the company's orders by equipping himself with a Sharp rifle; a Colt navy revolver and two pounds of balls; a knife and sheath. Each coach carried three sacks of letters, averaging 170 pounds in weight and a newspaper bag of about 140 pounds.

While the South enjoyed the efficient mail service made possible by the Butterfield line, the people of the North were protesting bitterly over the slow, wagon mail service provided by George Chorpenning. The result was that several attempts were made to cancel Butterfield's contract in favor of a more northerly route; but all attempts failed.

Then came 1860; storm clouds were gathering over the Nation. The old question of slavery between the North and the South had become a bitter issue, threatening open conflict. Seven states had already seceded from the Union. The problem of communication and transportation between the East and the West now became a major concern. The long round-about southern route versus a more central northern route became a hotly contested issue. The matter was finally settled, when on March 2, 1861, Congress voted that mail service on route 12578 be discontinued; and that the Butterfield service be transferred to the central route. Thus the old southern route

of the Overland Mail came to a glorious end.

More than any other institution, the Butterfield Overland Mail contributed to the development and expansion of the great Southwest. A quarter of a century after its abandonment, the old Butterfield Trail continued to be a main artery of travel for cattlemen, homesteaders and traders. Still later it served as a guide for the railroad builders, who, in many sections, established their grades over the rutted tracks of the old trail. Today, the best all-year route for automotive travel between St. Louis and San Francisco approximates the line of the old stage route, over which Uncle Sam's mail first rolled westward more than 90 years ago.

As sources of information, the author acknowledges:

Walter B. Lang: The First Overland Mail, St. Louis to San Francisco, 1858-1861. Printed by the Roycrofters, New York, 1940.

Lyle H. Wright and Josephine M. Bynum, editors, The Butterfield Overland Mail, by Waterman L. Ormsby. Huntington Library, San Marino, California, 1942.

Oscar O. Winther: Via Western Express and Stagecoach. Stanford University Press, Stanford University, California, 1945.

Roscoe P. Conkling and Margaret B. Conkling: Butterfield Overland Mail, Vol. 2-3. Arthur H. Clark Company, Glendale, California, 1948.—A. F. S.

Chapter XI

Crossing the Sierra

By Stewart Mitchell, *Principal Bridge Engineer*

Traffic arteries connecting the Central Valley and San Francisco Bay with the East have played an exceedingly important part in the growth and development of California. All of them must cross the rugged mountain barrier which stands along the State's eastern border. Since no highway or railroad was ever built across the higher portion of the range extending south from Yosemite National Park, there is a gap of about 150 miles that separates the "northern" and "southern" routes to California. It is these northern routes that are covered in this article. They were particularly prominent during the period of settlement and early growth and are still a very vital factor in the economic and social life of the State.

Plodding toward California in their wagon trains the immigrants faced one obstacle after another. Whenever the going was difficult they spoke of it as "seeing the elephant." The crossing of the last mountain barrier between them and California usually provided the biggest elephant of all. Now, however, the almost trackless routes they followed have become graded roadways supporting a smooth ribbon of pavement. The ox carts have been replaced by speedy, smooth-riding automobiles and what was a slow, toilsome and hazardous journey is now an easy jaunt, free from discomfort if not altogether from hazard. After 100 years of travel across the Sierra the "elephant" is no longer to be seen.

The immigrants generally referred to this last great mountain barrier as the "Sierra." To be exact, the mountains of Lassen Volcanic National Park and those to the north of it are part of the Cascade Range. This range consists of high plateaus capped by volcanic cones and lava ridges through which rivers like the Pit and its tributaries have cut deep and winding paths. Two great volcanic cones, Mt. Shasta and Mt. Lassen, are landmarks which have guided travelers since the earliest times. On the other hand, the Sierra Nevada, which stands squarely across the more direct east-west routes, is a tilted block of the earth's surface surmounted by remnants of an older mountain range. The upraised, easterly edge of this block forms steep escarpments and rises to a serrated crest which gave the range its name. The surface of the block, which slopes gradually down toward the Central Valley, has been carved by stream and glacier into an irregular pattern of canyons and intervening ridges.

Pioneer Exploration

The first settlers and their guides discovered and opened up trails along all the passable routes through the mountains—and some which hardly deserved the term "passable." The "pass" through which a trail crossed the summit usually bore the name of its discoverer. However, the location of the route was influenced by other factors than the existence of a particularly low gap or pass at the summit. Its directness toward a favored destination was, of course, a prime factor.

Natural approaches leading to the main summit had much to do with the location of the route. The early immigrants headed for one of the principal rivers of the eastern slope of the Sierra Nevada, either the Truckee, Carson or Walker. They followed the course of the river to the final escarpment at the summit and scrambled up it as best they could. Those who took more northerly routes through the Cascades could avoid the steep escarpment of the Sierra but had to travel a much longer way through rugged, dry and generally inhospitable country.

Without means to materially improve the roadway or to bridge canyons and streams the immigrants, after leaving the upland meadows of the Sierra, stuck to the top of a convenient ridge as long as possible and slid down the end of it when it ran out at a stream junction. They were always concerned with finding a reasonable supply of grass and water along the route but even though this is no longer a factor, the modern highways still follow, with but slight deviation, the trails of the pioneers.

The First Roads

While natural features of the terrain influenced the location of routes across the mountains, their development and relative importance were influenced by the events that took place and conditions that arose during the 100 years of California's statehood.

One might, on first thought, begin the history of roads across the Sierra with the year 1841 when the first train of immigrants, the Bidwell-Bartleson Party, crossed with pack animals in the vicinity of the present Sonora Pass. This party which followed up the West Walker River to the summit opened no trail across the mountains that was, or could be, followed by others. It is more fitting to begin with the year 1844 when the Stevens-Murphy-Townsend Party piloted by Caleb Greenwood, the 80-year-old "mountain man," was the first to bring wagons over the mountains into California. Furthermore, this party, which followed up the Truckee River and crossed over what is now known as Donner Summit, blazed a trail that was followed by immigrant wagons for the next two years. Then the war with Mexico put a temporary stop to immigration; the ill-fated Donner Party being the last wagon train to reach the eastern face of the Sierra in the late fall of 1846.

It took stout-hearted men and women and sturdy wagons to survive trails like this one over Kit Carson Pass in Alpine County. This photo of the route of pioneers was taken by Fred Werner of Sutter Creek and presented to Sutter's Fort by Mrs. Norma E. Werner-Ball of Jackson

Flood of Immigration

The discovery of gold in California, following immediately after the Mexican War, started a veritable flood of immigration to California. Setting out from the banks of the Missouri River in the spring of 1849, wagon trains plodded across the plains and mountains for nearly 20 years. Then the first transcontinental railroad was built, providing a more comfortable and rapid means of travel that superseded the picturesque prairie schooner.

Although the route along the Truckee River was favored by the earlier immigrants, the majority of wagon trains on reaching the Sink of the Humboldt, during the first years of the Gold Rush, headed for the Carson River and crossed the range via Carson's Pass. Fremont's report which told of crossing that pass in 1844 had called their attention to this route. Furthermore, many avoided the Truckee route because of the unfavorable publicity it had received as the result of the Donner Party's misfortune. The establishment of a trading post at Mormon Station (Genoa) in Carson Valley probably had a great deal to do with drawing immigrants to the Carson Pass route. But whatever the cause it became the heaviest traveled route into California for the first three or four years after the discovery of gold.

Early Promotion

Hope of avoiding the known hardships encountered along either of these routes and efforts to divert traffic toward particular areas resulted in new routes being scouted out. These were advertised by their discoverers and proponents as being preferable to all others. The merits of a particular route were influenced by what they, or the community they represented, hoped to gain if immigrants were diverted that way.

The earliest case of this kind was Peter Lassen's "Horn Route" over which he diverted many immigrants to his trading post at the mouth of Deer Creek in Tehama County. The trail he blazed left the Humboldt at Lassen's Meadows (near Imlay, Nevada) and went northward over the Applegate Trail to Oregon as far as Goose Lake in Modoc County, crossing the Warner Range by Fandango Pass instead of Cedar Pass on the present state highway. Then back again via Big Meadows (now Lake Almanor) to the destination he had chosen for them.

A glance at the map will show the humor, or tragedy, connected with the name "Lassen's Cut Off." Few traveled over this route after the year 1849 but many suffered terrible hardships before the nature of the route became generally known.

Sonora Immigrant Road

Another ephemeral wagon route was the "Sonora Immigrant Road." It is told that in 1853 one G. W. Patrick, Mayor of Sonora, a man of considerable persuasive power and not too much regard for the truth, influenced a number of immigrants to follow a route leading directly to the town of Sonora. This route followed the West Walker nearly up to its source and crossed the main summit of the Sierra some seven or eight miles south of the present Sonora Pass. For a season, immigrant parties struggled painfully over a route which today can be traveled only on foot or horse.

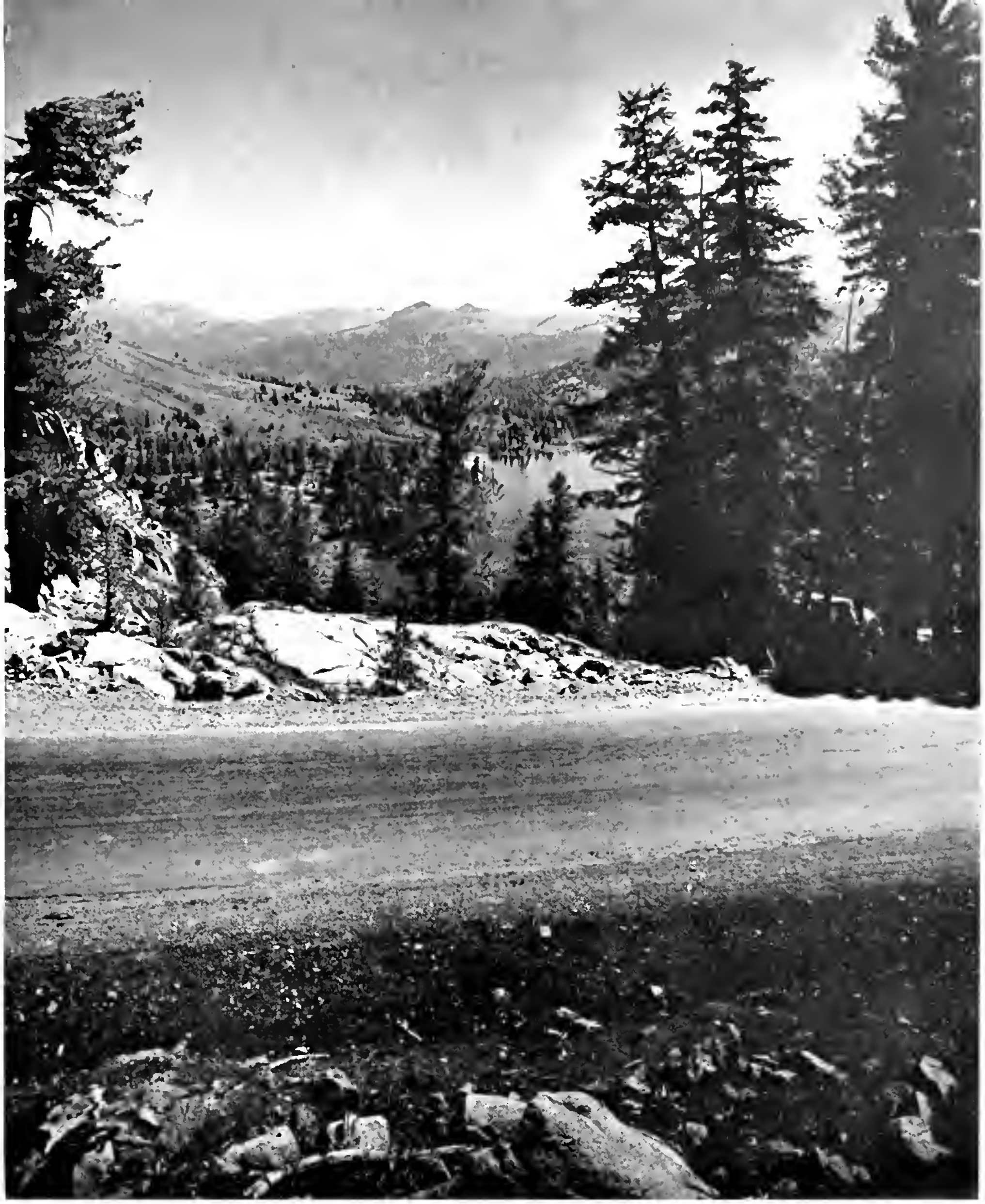
Early records refer to a pass discovered by "Major" John Ebbetts. Geo. H. Goddard, who knew the country as well as any surveyor of his day, referred to it as a route of great promise—probably the best one for a transcontinental railroad. Anyone who has driven over the present Ebbetts Pass highway (Sign Route 4) will wonder at this.

In 1853, the "pass" was pointed out to Goddard by Ebbetts from a mountain near Antelope Valley (probably Antelope Peak) from where it is certain they could not have seen the present pass. Anyhow, no immigrant train ever used what is now called Ebbetts Pass, which is on the stage road built later to reach the mining region of Silver City. However, an immigrant road starting from Murphys in Calaveras County was constructed and used extensively following its completion in 1856 and again during the summer of 1857. This road followed the route of Sign Route 4 to Hermit Valley but left it there and crossed over the divide via Faith and Charity Valleys into Hope Valley where it joined the Carson Pass Road.

Choice of Routes

Immigrant trains followed the early trail along the Humboldt River. At its sink, just below the present town of Lovelock, they had to make a decision. A 40-mile desert lay between them and either the Truckee or the Carson Rivers with a rendevous in either Truckee Meadows (where Reno is now located), or in Carson Valley. On reaching either place they had, by the year 1853, a choice of routes over the Sierra. The particular route chosen depended on the settlement or mining area they had picked on as their final destination. The popularity of the route increased or declined with the fortunes of the area it served and also with the ability of its proponents to convince immigrants of its real or fancied advantages. The pioneer spirit manifested by the early settlers in promoting their local interests matched the better organized efforts of today's chambers of commerce and other pressure groups.

From Truckee Meadows most of the travel continued up the Truckee River as far as the present town of Verdi. The Stevens-Murphy party followed the canyon of the river to Donner Lake, as does the present highway (U. S. 40),



Present day Carson Pass Highway—Red Lake is in background. Pioneer route shown on opposite page was just behind trees on right

but the trains that followed them turned from the river and climbed the "Dog Valley Grade" to the rolling plateau country above. This road, used and improved through the years, was taken over and maintained as a state highway until the present highway was built in 1925.

On climbing the grade the immigrants had a choice of two routes. One was the Truckee or Donner Pass route; the other a route that followed up the Little Truckee River past Weber Lake to Henness Pass. The former road is, in a general way, followed by U. S. 40; the latter by an unimportant county road. It was, however, the more direct road to the Yuba River mining regions and immigrants used it extensively in the late fifties.

Beckwourth Pass

Those whose destination was in the basin of the Feather River turned northward at Truckee Meadows and crossed Beckwourth Pass into Sierra Valley. This pass is now crossed by the Western Pacific Railroad. Jas. Beckwourth led the first wagon train this way in 1852 and in that train Ina Coolbrith, the first poet laureate of California, rode as a little girl. From Sierra Valley several routes diverged to the mining areas along branches of the Feather. One road led via

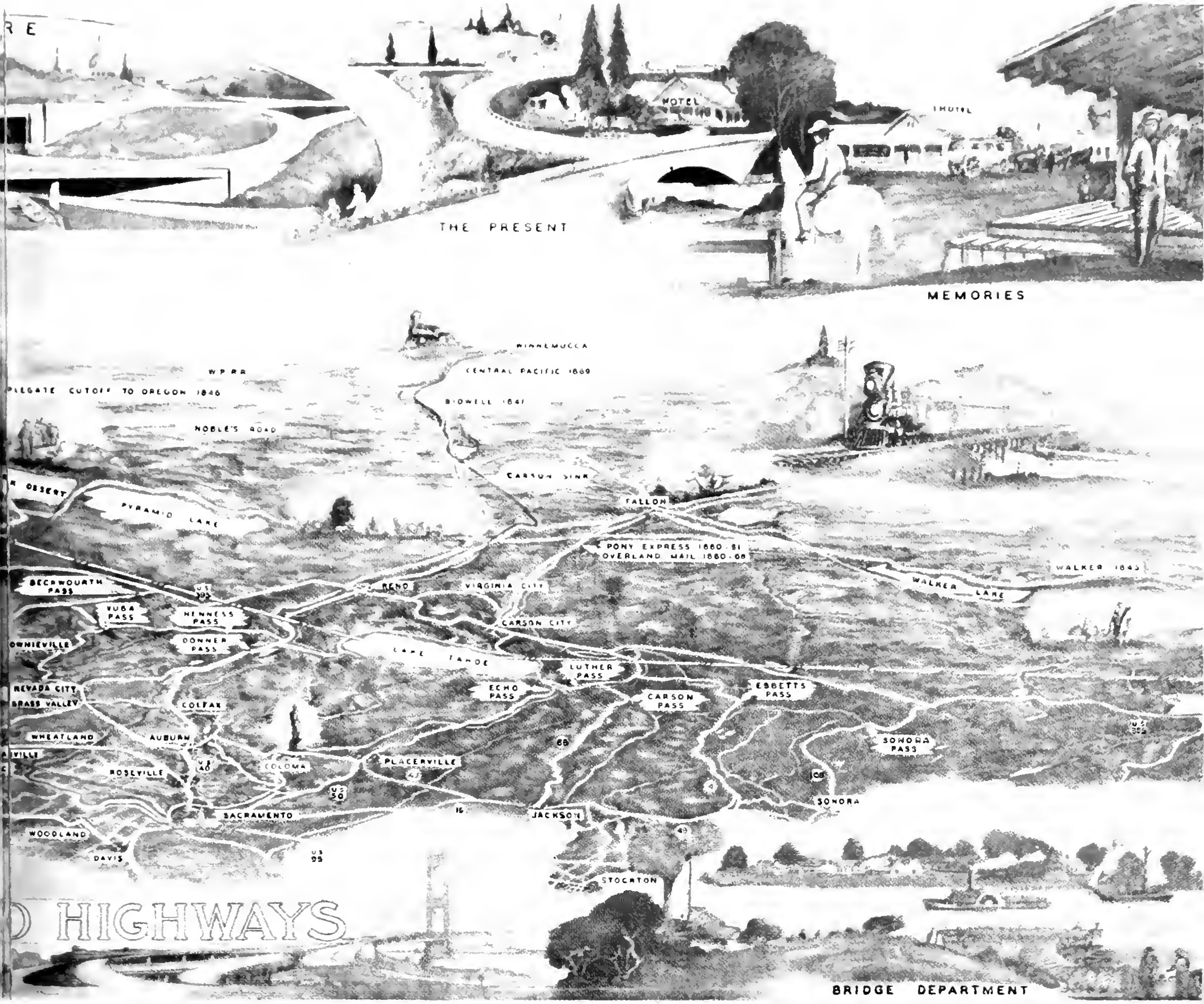
Quincy (American Valley and Bucks Ranch), another via Mohawk Valley and La Porte. A pack trail also crossed Yuba Pass to the North Fork of the Yuba River and Downieville but the first wagon road into that region was via the Henness Pass road and Goodyears Bar.

Abortive efforts were made to divert traffic over other routes crossing the main Sierra. Two of these crossed the Carson Range to Lake Tahoe. The "Placer County Emigrant Road" followed down the Truckee River and up Squaw Valley to the summit, then along the ridge south of the North Fork of the American River to Yankee Jims and Forest Hill. The other route crossed Lake Tahoe to McKinney's climbed to the summit, crossed the Rubicon River and followed the ridge to the south of the river to Georgetown. Although used by immigrants for short periods, neither of these routes became popular because of their indirectness compared to other routes. Portions of both routes are now followed by county roads.

Johnson's Cut-Off

As previously stated, much of the travel during the first years of the Gold Rush went via the Carson River and crossed the mountain via Carson Pass. In 1852, Col. J. B. Johnson opened a route across the mountains between Carson Valley and Placerville which, with a few deviations from its original location, has become highway U. S. 50. Johnson's "Cut off" gradually increased in popularity and importance, diverting travel from the Carson Pass road. Its chief advantage was lower elevation with relative freedom from snow in winter. This largely accounted for it being chosen as the route of the transcontinental mail and passenger stages.

As the more northerly mining regions in the Sacramento Valley developed, there arose a demand for a more direct



route from the Humboldt to the mining area around Ft. Reading and Old Shasta than either Lassen's route or the more southerly routes just described. A man named Noble scouted a trail which left the Humboldt at Lassen's Meadows and followed the Lassen or Applegate Trail to the Black Rock Desert. From there, however, he turned west along the edge of the Smoke Creek Desert and crossed over the hill into the Honey Lake basin. Going west from Susanville the route crossed the plateau at the head of Susan River and joined the Lassen Park highway just south of Manzanita Lake. From there it followed, approximately, the location of Sign Route 44 to the Valley.

Era of Trails

The decade of the 'fifties may be called the era of trails. It is true that some work was done by individuals for the purpose of collecting tolls or by organizations interested in improving the primitive condition of their local roads. However, no public funds for the purpose could be raised until toward the end of the decade. Such work as was done was of the order of clearing away brush and trees, removing rocks, building bridges and sections of causeway, etc. Even the stage roads between the valley and mining camps scattered throughout the mountains were the cause of endless complaints by travelers because of dust in summer, mud in winter, and general roughness of the roadbed.

However, it must not be thought that the people of California accepted the conditions without protest or made no effort to improve them. From the beginning the Americans devoted a great deal of energy toward better means of transportation across the Sierra. It was natural that their first choice would be the construction of a transcontinental railroad. Railroads had already proven their supe-

A MEETING OF THE OLD AND NEW—Straight ahead is the old Johnson Cut-off emigrant trail which climbed 1,000 feet from the floor of Lake Valley to Echo Summit in three-quarters of a mile. To the right is the two and one-half mile Meyers Grade, the lower hairpin turn of which has been cut off by the modern highway of U. S. 50

riority as a rapid and economical method of transportation and were fast supplanting the stage and canal boat throughout the East.

By 1850 a network of tracks extended as far west as Chicago and financing appeared to be the only obstacle in the way of extending a track to the Pacific Coast. The value of such a railroad seemingly was accepted by all. Federal assistance was needed but this was withheld for another decade because of sectional rivalry and political jealousy.

Congress Orders Survey

The contending sections and proponents of various routes could, and did, agree on the need for better information on the country through which a railroad would have to be built. As a result, an act was passed by Congress in 1853 which provided for "A careful reconnaissance of the proposed routes for a railroad from the Mississippi Valley to the Pacific Ocean."

Five routes were surveyed, only one of which crossed the mountains in Northern California. This one reached the eastern border of the State in the vicinity of Honey Lake and from there it was thought that a railroad could be built to reach the Sacramento Valley either along the location of Nobles Road or somewhat farther to the north via Madeline Plains and the Pit River. No consideration whatever was given to Donner Summit which was to be on the route of the first transcontinental railroad, the Central Pacific, or to Beckwourth Pass through which the Western Pacific Railroad was later built.

Californians Disappointed

The report on the explorations, signed by Jefferson Davis who was the Secretary of War, indicated that any route across the Sierra was impractical chiefly because of the deep snows. Instead it recommended a route which swept in a great arc down to the Mexican border and back up to San Francisco which was hundreds of miles longer.

It would be putting it mildly to say that the citizenry of the State, who favored a direct route from Salt Lake City as a means of speeding up the mail service and facilitating immigrant travel, were disappointed and dissatisfied with the decision of the Secretary of War. They soon realized that the political conditions preceding the Civil War had made immediate agreement on the route for a transcontinental railroad very unlikely. Therefore, they turned their energies toward the building of a transcontinental wagon road along the Salt Lake trail as a temporary measure.

Popular clamor, evidenced by petitions and recommendations from organized groups of citizens in San Francisco, Sacramento, Marysville, Placerville, and other cities and towns, caused the State Legislature to act. A bill was signed by the Governor on April 28, 1855, which provided for the construction of a wagon road from the Sacramento Valley to the eastern border of the State. The road over the Sierra to Carson Valley was to be let to contract at a cost not to exceed $105,000 including the cost of the survey. As to the survey the act stated: "The Surveyor-General of the State shall cause to be surveyed a good wagon road over the Sierra Nevada Mountains at an ex-

pense not to exceed five thousand dollars; and no further liability shall be incurred for this purpose." But the Legislature failed to appropriate the $5,000 dollars!

The Day Survey

The Surveyor-General, H. S. Marlette, undaunted by this negligence, appealed to local citizens and the supervisors of the counties interested in a road terminating in Carson Valley. Enough money was raised by June, 1855, so that a survey of practicable routes could be started by Sherman Day, civil and mining engineer and State Senator. Starting from Georgetown he followed the general route of the immigrant road to Lake Tahoe previously mentioned. Then Marlette and he together made a reconnaissance of the Carson and Johnson Pass routes. Day reported that, as the result of his explorations, these two routes only were worthy of further consideration. He further intimated that if it were considered necessary to provide for winter as well as summer travel, then only one route (Johnsons) need be surveyed and let to contract immediately thereafter.

It was evident to him that the high elevation of such a long portion of the Carson route, and the fact that deep rock cuts would be required and would fill with snow, made it an impractical one for winter travel. The highway maintenance forces who must dig their way through the snow each spring on the present road around the Carson Spur will appreciate the wisdom of his recommendations.

The Goddard Survey

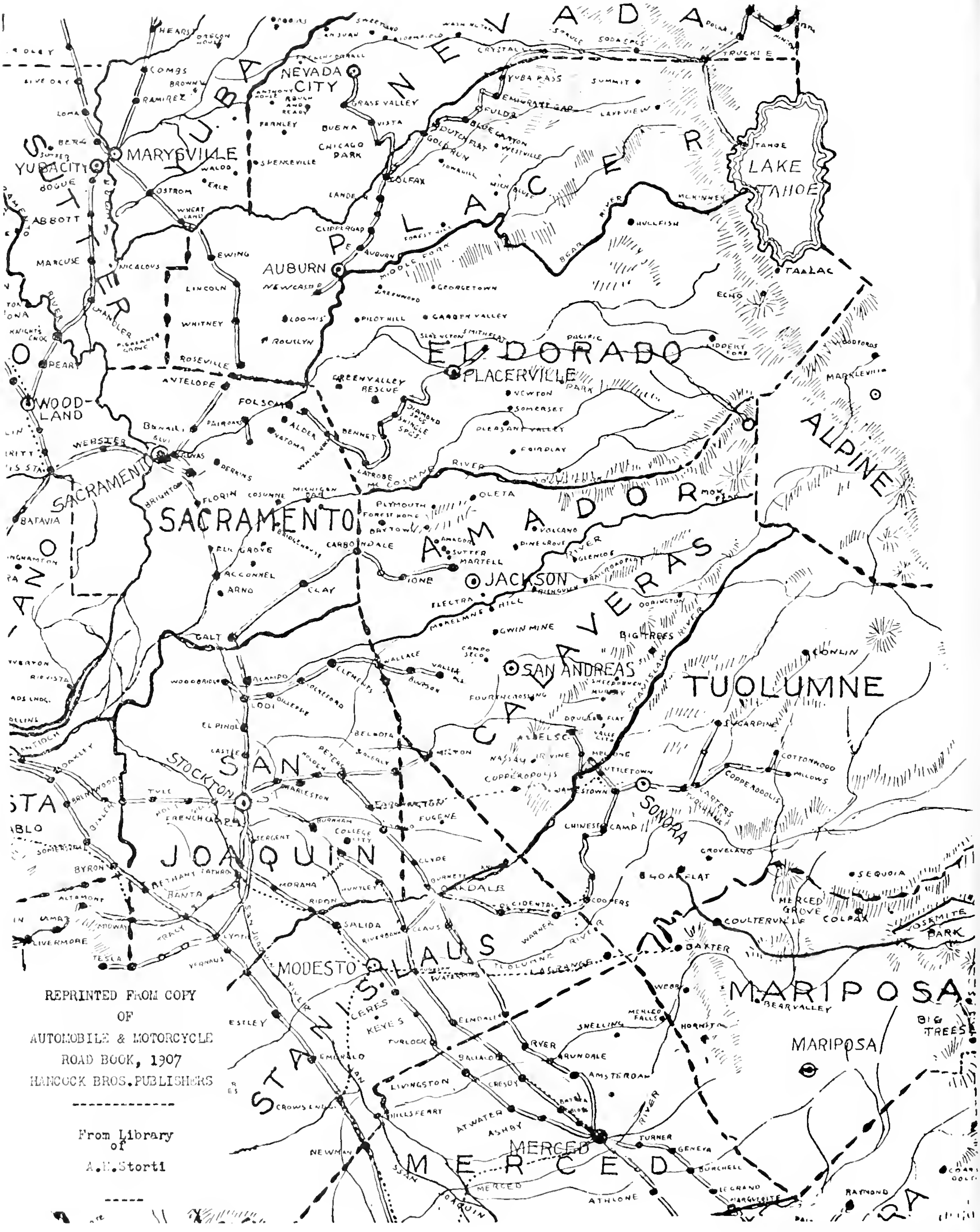
At this time the Legislature of the Mormon territory of Utah wanted to set up a local government in Carson Valley and, in consequence, found it necessary to establish the easterly boundary of California. Orson Hyde to whom the task had been delegated called on Marlette for assistance and the latter employed George H. Goddard, artist and engineer, to make the survey—apparently at Hyde's expense.

This gave Marlette another opportunity to obtain information on the merits of the existing routes as indicated by his instructions to Goddard:

"From Placerville to Carson Valley, via Cold Spring Ranch and Carson Pass, you will take such barometrical observations as will enable you to construct a profile of the route. You will also take, so far as practicable, a somewhat accurate sketch of the country traversed, and collect such other data as in your opinion will be of service in comparing the merits of this with other routes, for the Immigrant Wagon Road, in respect to both practicability and economy of construction." **The route to be followed on the return trip was to be decided later. The Johnson Route being chosen, like information was obtained along it.**

This is U. S. 50 on Echo Summit today, replacing old Johnson Cut-off and old Meyers Grade shown on opposite page

We are indebted to the reports of Day and Goddard for the most complete and trustworthy information regarding these two important immigrant roads. On the basis of their reports, local officials became convinced of the practicability of building a road over the Sierra via Johnson Pass but opposition by various interests prevented the appropriation of funds by the State Legislature. Furthermore, the constitutionality of the State Wagon Road Act was challenged and it was finally declared to be un-



REPRINTED FROM COPY
OF
AUTOMOBILE & MOTORCYCLE
ROAD BOOK, 1907
HANCOCK BROS. PUBLISHERS

From Library
of
A. H. Storti

constitutional by the Supreme Court on December 8, 1856.

Several Routes Surveyed

Meanwhile, the citizens in other parts of the State were not idle. All the interior towns wanted to be the terminus of the first transcontinental road. Several routes were surveyed and advocated by various communities.

D. B. Scott had made a reconnaissance along the Henness Pass Route from the Truckee River to Camptonville and reported his findings to the Surveyor General. A. P. Chapman also had reported on an alternate route via Yuba and Beckwourth Passes which left the Henness Pass Road just south of Goodyears Bar. Then O. B. Powers of Calaveras County made a report to the Surveyor General covering the route from the Calaveras Big Trees to the Carson Road in Hope Valley. Construction work started on this route with funds raised locally and the Calaveras Chronicle of August 23, 1856, stated that this road, "the first over the Sierra," was ready for travel. As already mentioned, a considerable portion of the immigration used this road for a season or two but then went elsewhere because of failure to maintain it in passable condition.

Various Routes Proposed

Also in August of the same year a party headed by John A. Brewster, the newly-elected Surveyor-General, made a reconnaissance from Downieville over Yuba and Beckwourth Passes to the Truckee River, returning via Henness Pass. A considerable portion of the route they traveled was that previously covered by Chapman and Scott. Nothing in the way of road construction followed the completion of these surveys.

Wm. Gamble and Job T. Taylor proposed a route over the mountains which they claimed could be constructed for $5,000. From Marysville it was to follow the route of the present county roads through Magalia, Humbug Valley, Big Meadows (Lake Almanor) and join Nobles Road near the head of Susan River.

A party led by Thomas A. Young, surveyor for Placer County, surveyed the route of the "Placer County Emigrant Road" previously mentioned. He reported that it was his impression the road could be built with less expense than any other route.

Memorial to Congress

None of these routes received the support or backing evidenced in favor of a route out of Placerville. But the rivalry and conflicting reports tended to cloud the issue insofar as the Legislature was concerned. The year 1856 passed without any work being done on the Marlette-Day survey.

Meanwhile progress was being made toward favorable action by the Federal Government. A transcontinental stage line had been incorporated and its directors appealed for aid to Congress and asked the cooperation of the citizens of California. This resulted in a petition (signed by 70,000 or more persons it is claimed) which was forwarded to Congress asking for the immediate construction of a military wagon road along the Central Overland Trail via Salt Lake. This impressive memorial aroused the support of eastern businessmen and bankers and forced Congress to act.

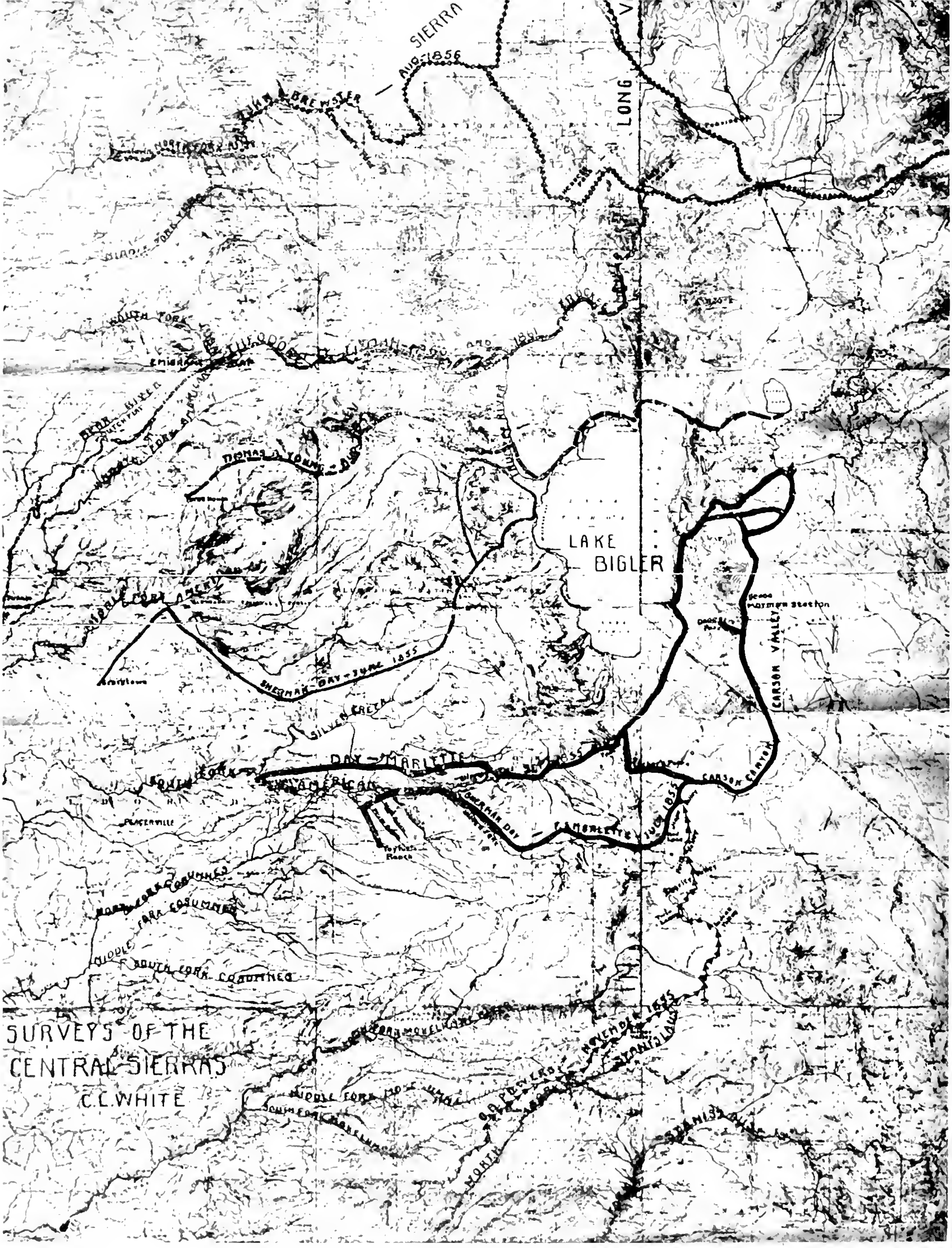
A wagon road act was signed by President Pierce in February, 1857, but because of the political situation, the act also provided for the improvement of the southern or border route. It received $200,000 and the Salt Lake route received $300,000. However, there was a catch to this latter appropriation—the terminus of the road was to be Honey Lake and not Carson Valley which the larger part of the citizenry favored. This again raised the hopes of the people of Lassen and adjacent counties who became quite vehement in their opposition to the Johnson Pass Route. In spite of the disappointment over the action of the Federal Government a few optimistic Californians refused to give up the fight for the more direct route via Carson Valley.

Counties Unite

No help could be expected from the powerful California Stage Co. which had moved its headquarters to Marysville be-

"THE PROMISED LAND"—Andrew Grayson, his wife and son, looking out on the distant Valley of the Sacramento, the goal of Grayson's ambition since childhood. Grayson and his family were part of the Donner Party which turned off at Fort Bridger and arrived in California safely after a six months' journey. A few years later Grayson paid the artist Jewitt $2,000 to paint this picture.
From the painting by Jewitt, in Sutter's Fort Historical Museum

The map of 1907 on opposite page indicates that the Placerville Road, now U. S. 50, was the only route passable for automobiles crossing the Sierra. Donner Summit and even Nevada City could be reached by railroad only. Directions in the road book from which the map was taken included such remarks as "Follow telephone poles," "Very dusty in places," and "Grade steep and rough"


SURVEYS OF THE
CENTRAL SIERRAS
C.L. WHITE
LAKE
BIGLER
CARSON VALLEY
CARSON CANYON
SHERMAN DAY-JUNE 1855
DAY-MARLETTE
SIERRA
AUG-1856
LONG
SILVER CREEK
AMERICAN
PLACERVILLE
NORTH FORK COSUMNES
MIDDLE FORK COSUMNES
SOUTH FORK COSUMNES
SOUTH FORK AMERICAN
BEAR RIVER
NOVEMBER 1855
MIDDLE FORK MOKELUMNE
Mormon Station
THEODORE

cause of the extension of the railroad from Folsom toward that city. It naturally favored more northern passes leading toward Honey Lake. Representatives of several counties in the San Joaquin Valley held a meeting at which Surveyor-General Brewster and "Snowshoe" Thompson spoke of the superior advantages of the Big Trees Route. Proponents of other routes also held meetings, appointed committees, and talked of raising the all-important funds. But, they raised no funds and events began to shape themselves in favor of the Johnson Road.

The Counties of Yolo, Sacramento, and El Dorado subscribed a total of $50,000 for the construction of a wagon road on Sherman Day's survey and a Board of Wagon Roads was appointed. The noted stage driver, J. B. Crandall of the firm of Crandall and Sunderland, who operated the stage line between Placerville and the railroad at Folsom, offered to drive the members of the board over the route. The trip starting on June 11, 1857, was a rough and rugged one but it demonstrated to the Nation at large that a stage route across the terrible Sierra was quite practicable. The trip provided the board an opportunity to learn first-hand which sections of the route were most in need of improvement.

First Stage Trip

It is perhaps to be regretted that Crandall was not the first to drive a stage across the mountains. Only a few days previously, the California Stage Co. had taken a convivial party from Marysville to Honey Lake and back along the route proposed by Gamble and Taylor. Since the trip did not lead to the inauguration of any stage route, and apparently stimulated no road construction toward Honey Lake, it may be considered of relatively small importance.

A considerable amount of work was done on the road during the summer of 1857 by private subscription. By legislation passed in May, 1858, a Wagon Road Commission was appointed with power to award a contract for the construction of a road following Day's survey as closely as practicable. With the money raised by the interested counties a contract was let on June 29, 1858. The contractor was unable to complete his contract and the remaining work had to be relet. There were arguments among the road officials as to whether the work, finally completed in November, 1858, fulfilled the contract; but differences were ultimately adjusted and the contract accepted. These events mark the beginning of wagon road construction across the Sierra which gradually replaced the pioneer wagon trail.

Crandall Stage Route

Crandall's stage followed the Johnson immigrant road until the county road on the Day survey was constructed. The immigrant road crossed the South Fork of the American at Brockless' Bridge (just north of Pacific House), and climbed to the top of Peavine Ridge to avoid the spurs and ravines of the canyon. The county road which also crossed the Brockless Bridge was cut into the north wall of the canyon opposite the modern highway and far below the immigrant road on the ridge. Near Silver Fork the county road descended to the bottom of the canyon and followed the line of the present highway past "Georgetown Junction," where the immigrant road joined it, to Strawberry some four miles further east. From that point the old and the new roads follow along the South Fork past Twin Bridges to Echo Summit.

After dropping from the summit of the Sierra into Lake Valley it was necessary to again climb over the equally lofty summit of the Carson Range before reaching the level of Carson Valley. Johnson's road crossed the Carson Range at the head of Clear Creek (Spooner Summit), as does highway U. S. 50. It did not drop directly down to the level of Lake Tahoe as does the modern highway because of the difficulty of passing the rocky spurs that jut into the lake and the swampy ground at the mouth of the ravines between the spurs. Of this portion of the Johnson Road, Sherman Day, in 1855, had this to say:

Day Report

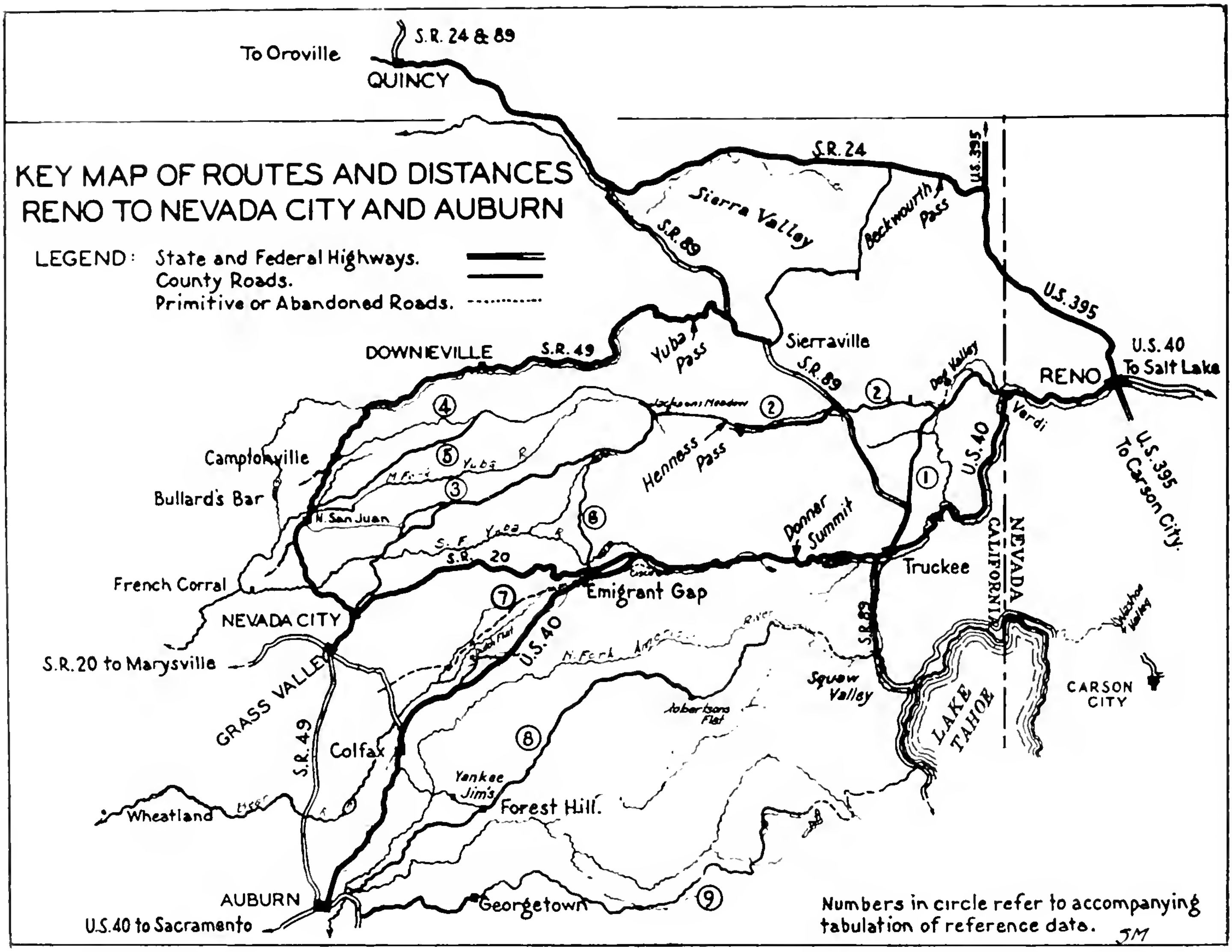
"It winds its way along the western side of the mountains near the origin of the larger spurs and gulches, and—as it appeared to me—(although I had no instrument with which to test it) in several cases ascends to a much greater altitude than that of the pass through which it crossed the summit. Certainly the sum of the ascents and descents in climbing six or seven of these lofty spurs would have sufficed to have crossed directly over the highest knobs of the mountain, at almost any point. Before the old road through the Carson Canyon had been improved, this wagon road was probably preferable to that as a mode of approaching Bigler Lake Valley and the western portion of Johnsons Cut-off Road; but at present, I think any person knowing the two routes would much prefer to reach the upper pass of Lake Valley, by passing through the Carson Canyon and then through Luthers Pass; and I believe that this is now the opinion of Mr. Johnson, the original explorer and improver of the cut-off through the Eagle Ranch Pass."

Crandall's stages traveled via Luthers Pass which Day says was first crossed by wagon in 1854, by "Mr. Luther of Sacramento." He further remarks: "This pass is, naturally, one of the best I have seen over this range of mountains. Several miles of it are now good natural road. The other portions need grading and the removal of rocks."

Johnson's Road

Johnson's Road crossed the summit of the Sierra at the same point as did the Meyers Grade which was abandoned some 10 years ago except as a stock trail. The Hawley Grade, built in 1858, crossed at a point about three-quarters of a mile farther south, as recommended by Day. It is buried by the fill of the present highway which crosses at the same location. The Hawley Grade ran south and reached the valley floor about where the present grade on SR 89 starts up to Luthers Pass. Over Luthers Pass and the Hawley Grade came Horace Greeley on the trip made famous by his ride into Placerville with Hank Monk. By September, 1860, Kingsbury and McDonald had finished a toll road over Daggett's Pass through the Carson Range, now known as the Kingsbury Grade, and by the end of the same year they apparently had a passable road along the Meyers Grade from Lake Valley to Echo Summit. Completion of these roads again diverted traffic toward the route originally laid out by Johnson.

The fact that the mail carried over the Central Route traveled by way of Placer-



GENERAL NOTE: U. S. 40 follows in general the route of the Central Pacific Railroad and, except for highway realignments in the vicinity of Dutch Flat and Cisco and routes (1) and (7) noted below, is on the general route of both immigrant and stage roads. The latter known as the "Dutch Flat and Donner Lake Wagon Road" connected with the railroad as it was built eastward. (Newcastle, May, 1864; Colfax, 1865; Cisco, 1867.) Stage and freight business was practically diverted from the Placerville road by 1867.

(1) *County road on the immigrant trails to Donner Summit and Henness Pass. It was also the "Dutch Flat and Donner Lake" stage road and maintained as the state highway until the present highway was built through the Truckee Canyon in 1926. (Immigrants descended into Dog Valley but the road follows the ridge and the "Dog Valley Grade."*

(2) *"Henness Pass road, now a graveled road east of Weber Lake and unimproved west to Jackson's Meadow where it divides, one branch via Forest City and the other via the "San Juan Ridge" (3). Used by immigrants during the fifties and by stages and teams 1860-68. (Second in importance to the Placerville road.)*

(3) *Graveled road via Bowman Lake, Graniteville (Eureka) and North Bloomfield to Nevada City. Road built by the Henness Pass Turnpike Co. in 1860.*

(4) *Unimproved road on the route followed by immigrants coming through Henness Pass. Stages first ran to Camptonville, the terminus of the stage line from Marysville. (A road ran north from Forest City to Goodyears Bar and Downieville.)*

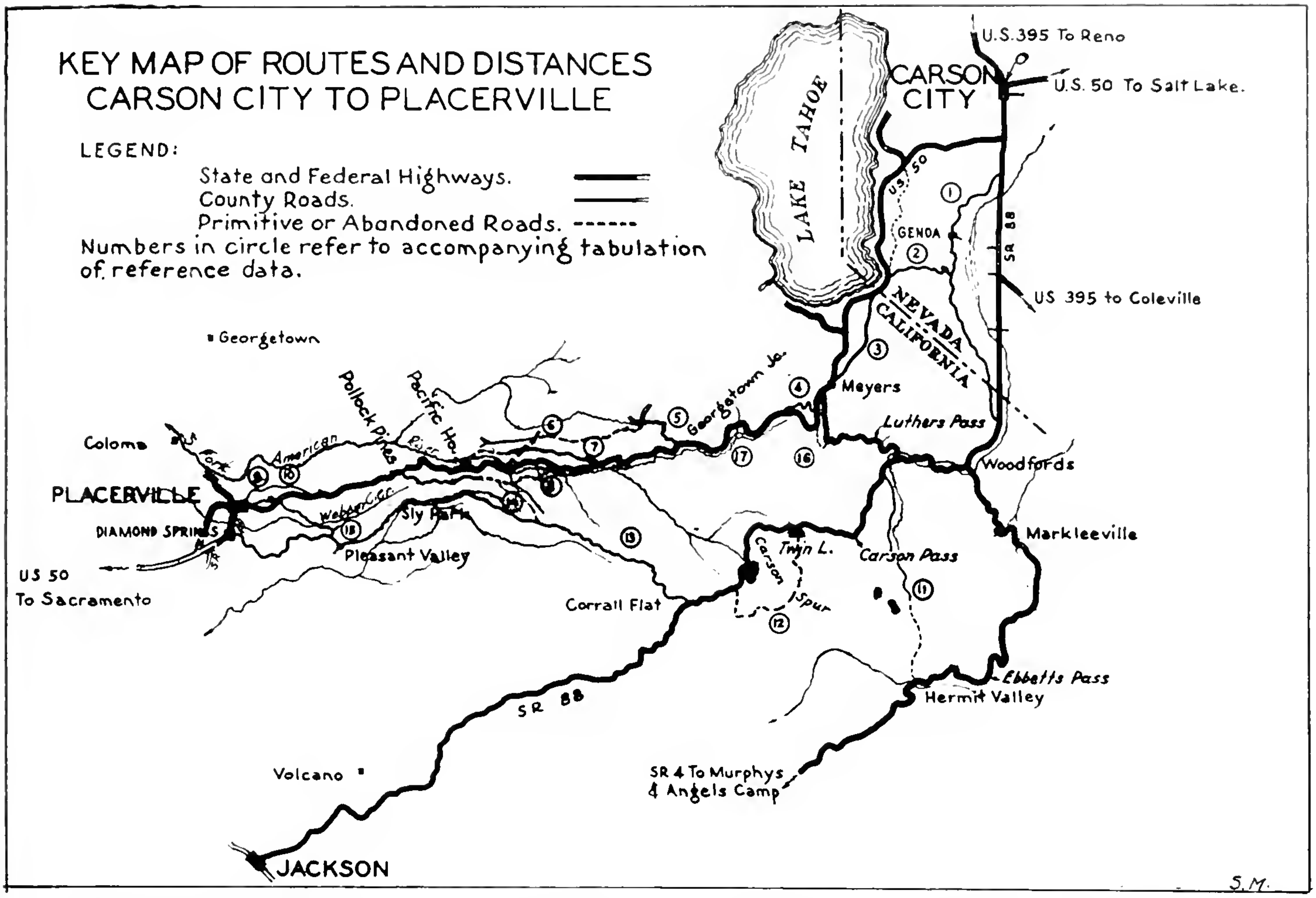
(5) *County road from Forest City to North San Juan connecting with the stage road through French Corral and Smartsville. Route followed by immigrants and later by the stage road built by the Truckee Turnpike Co. in 1860. Both companies (See (3)), cooperated in building the road east of Jackson's Meadow.*

(6) *An unimproved county road, built as the "Culbertson Grade" in 1864 to connect the railroad and the Dutch Flat road at Emigrant Gap with the Henness Pass road.*

(7) *Immigrant route, Bear Valley to Johnson's Ranch (near Wheatland). Now unimproved roads or trails.*

(8) *Route of "Placer County Emigrant Road" (1852). Now a county road as far as the summit.*

(9) *County road to Wentworth Springs and from McKinneys to Miller Lakes. Route used to some extent by immigrants. (Surveyed by D. B. Young, 1856).*



(1) *County road via Genoa. On the route followed by immigrants via the Carson Canyon (just west of Woodfords), and used by stages going via Luthers or Daggetts Pass.*

(2) *"Kingsbury Grade" over Daggetts Pass, completed in the summer of 1860 and used by stages and freight teams until traffic was diverted to the present route via Spooner Summit ("Waltons Road" completed November, 1863, now U. S. 50).*

(3) *Stage road, via the Sierra House. A graveled road maintained as a state highway until 1931 when the present highway via Bijou was built. Stages also traveled via "Lake House" located on the lake shore east of the Upper Truckee River.*

(4) *"Meyers Grade," completed in the fall of 1860, crossing Echo Summit and used as the state highway until 1940 when the upper portion was rerouted via the Hawley Grade ("Henderson's") summit. (The reconstruction of the lower portion completed 194?.) The emigrant road over "Johnsons Pass" reached the Echo Summit in a distance of about three-fourths mile starting near the site of the Lake Valley Ranger Station.*

(5) *An unimproved county road which was a portion of the Georgetown-Virginia City stage road. It leaves U. S. 50 at the site of "Georgetown Junction" (chimney) and is somewhat below line of the immigrant trail which climbed to the top of Peavine Ridge.*

(6) *Existing primitive roads and stock trails which follow the route of the immigrant road down Peavine Ridge to Bartlett's Bridge (site near Pacific Ranger Station) and, after 1855 to Brockliss Bridge (at site of present bridge below Pacific House).*

(7) *Road built by the counties in 1858 from Brockliss Bridge to Cedar Rock, near Silver Fork, and used by stages and freight teams during 1859-61. Used by stages and westbound (light) freight wagons afterward. Route of the first transcontinental telegraph. Generally abandoned to the west of the Riverton-Ice House road and still unimproved road to the east of it.*

(8) *"Oglesby Grade," toll road used by stages and teams during 1861-64 leaving U. S. 50 about the 14-mile stone (west end of Pollock Pines) and joining it again east of Whitehall. Bridge and road at east end out are abandoned. Road still used at west end. Road, along the present general highway route, via Fresh Pond and Riverton (Moores Station), was built about 1864 at which time Oglesby Road was being rebuilt on lower grade on opposite side of the river.*

(9) *Existing oiled county road via the "Hill Road" east of Placerville. It follows the general route of the immigrant road and was also used by stages.*

(10) *Existing oiled county road via Smith's Flat, the route of the stage road and of the state highway until 1932.*

(11) *County road from Hope Valley to Blue Lakes and a forest trail to Hermit Valley. On the route of the original "Big Trees" road which generally follows the existing oiled State Route No. 4. Stage road to Silver Mountain and Markleeville built in 1864 from Hermit Valley over the present Ebbetts Pass.*

(12) *Abandoned route of the immigrant road over the Carson Spur ("West Pass"). The present oiled State Route No. 88 follows the stage road (built 1863-64 as the "Amador and Nevada Wagon Road") via Silver Lake and around the end of the Carson Spur.*

(13) *Unimproved county road along the ridge, on the route followed by immigrants going to Placerville (Hangtown) or Diamond Springs via the Carson Pass.*

(14) *Unimproved roads and trails along the emigrant route of the fifties which left the present county road near Iron Mountain and followed down the divide between Plum and Sly Park Creeks, via "Cold Springs" (near Zumwalts), to a junction with the Johnson's Pass road above Fresh Pond. Road branched near the "Junction House" to Pleasant Valley and Diamond Springs.*

(15) *Various county roads, graded and oiled, follow immigrant and stage roads used at various times, via Stonebreaker Grade to Sly Park and Pleasant Valley and then to Placerville (via Newtown), to Diamond Springs or to the Cosumnes River mines.*

(16) *Forest trail on the "Hawley Grade" built by El Dorado County in 1858 on the stage road via Luther's Pass. Used during 1859-60, when traffic was diverted to the Kingsbury Grade. See (2).*

(17) *"Slippery Ford Grade" on the stage road, and maintained as the state highway until 1931 when highway was rerouted between Strawberry and Sayles Flat.*

Over the plains and across the great American deserts, lay the path of Empire. Courtesy, University of California

ville had much to do with the improvement of roads between it and Carson Valley. The change of the Overland Route from the Humboldt to Simpson's Route (followed by U. S. 50 for a considerable part of the way) more firmly fixed Carson Valley as the terminus for the stage road across the Sierra. Perhaps, had the political scheming of the Postmaster General not forced the mail to the southern route, to be carried in the stages of Butterfield, more work might have been done on the northern or central route.

Butterfield Route

The Butterfield Route entered the State at Yuma, dipped into Mexico, passed through Warners Ranch in San Diego County on the way to Los Angeles, crossed the Tehachapi and followed along the eastern edge of the San Joaquin Valley to Visalia, thence to Fresno City, now nonexistent, and then across to Pacheco Pass and San Francisco.

Starting on September 15, 1858, Butterfield stages operated regularly and efficiently until the outbreak of the Civil War which put a stop to travel through the South. Whatever influence the transcontinental mail route may have had, it is certain that an event which now occurred close to the borders of California had a much more important effect on the construction of better roads across the Sierra. This was the discovery of silver in Nevada (and also Idaho), particularly the discovery of the Comstock Lode in 1859. By 1860 the rush was on.

Road Quagmire

The Sacramento Weekly *Union* of March 17, 1860, describes the condition of the recently built county road as a "continuous quagmire." It went on to say that walls have slid away, there are no proper culverts, and, if funds are not provided for repairs, the investment will be lost. In October, 1860, the same paper reported that: "After hauling a load from Sportsmans Hall to the bridge (Brockless), which includes a section of some seven miles of the hardest road on the route, teamsters will be disposed to pronounce the graded road built by the two counties a first rate one for the mountains. The objections are the width, drainage and the location. It is too narrow; it is not properly drained; and in the opinion of those best acquainted with the route, was not judiciously located by the engineers."

Toll Roads Legalized

It was evident that neither the needed road improvements nor proper maintenance after a road was built was to be depended upon when the funds came from the public treasuries. In consequence, there grew up a policy of granting franchises to collect tolls to persons who constructed new roads or improved sections of the existing roads. Competition, or the threat of it, brought about a great improvement in the standards of construction and maintenance of the principal roads used for staging and freighting to the mines of Washoe and elsewhere. Additional roads were constructed as soon as new developments indicated their probable value. All this brought about an era of road-building across the Sierra which, in general, reached its heyday in 1865 and then declined with the building of the transcontinental railroad.

In the fall of 1861, Oglesby began the construction of a road on the south slope of the South Fork Canyon. At that time the road going east from Sportsmans Hall stayed on the ridge to the "Junction House" at the head of Fresh Pond Ravine. From there the Johnson Road descended the ravine to a crossing of the South Fork of the American River, first at Bartletts Bridge (just north of Pacific Ranger Station) and then, after 1855, at Brockless' Bridge.

The Carson Pass road continued easterly from the Junction House and climbed to Iron Mountain along the divide between Plum Creek and Sly Park Creek. Ogelsby's road left this at "Five Points," descended the canyon slope on a fairly regular grade, crossed the South Fork and continued up the river for four miles to a junction with the county road near the present Silver Fork store.

Floods of 1861-62

The unusual floods of the winter of 1861-62 raised havoc with the roads and left the road built by the counties in particularly bad condition. The general condition of the road is described by a correspondent of the Sacramento Weekly Union writing from Strawberry on April 14th. Snow was still falling. Stages were running from Placerville to a point 25 miles east of there. The remaining 22 miles to Strawberry had to be covered on horseback. From Strawberry to Lake Valley sleighs were being used and from there to Carson Valley it was again necessary to travel on horseback. As to the county road, he stated that the stages, which had their stations and feed on the "old road up the north side of the river," went that way but all other travel went over the Ogelsby Road which was in better condition. The South Fork Bridge, however, was washed out and would not be rebuilt for a month. Later sources of information indicated that loaded feight wagons always used the Oglesby Toll Road even when the county road was toll-free, and that the latter road was used by the stages and by freight teams returning empty from Nevada.

Slippery Ford Grade

Other important work done on the Placerville Road during the first years of the decade included the construction of the Slippery Ford Grade and its operation as a toll road by Swan. By 1865 a road had been built on the route of the present highway between the 14-Mile House (east limit of Pollock Pines) to a junction with the Oglesby Road where it crossed the river, passing through Moore's Station now called Riverton. It was built and operated as a toll road by Pearson and McDonald and the reconstruction of the Oglesby Road on a lower and better location could not prevent it becoming the main artery of travel. On the Nevada side, Walton's Road up Clear Creek to Spooner Summit (the present route of U. S. 50) being gradually improved and supplemented by the construction of the Kings Canyon Road in 1863, traffic was diverted from the Kingsbury Grade. The road construction during the years 1860-65 fixed the location of what came to be known as the "Lake Tahoe Wagon Road" for 60 years or more.

Henness Pass Road

The chief rival of the stage road through Placerville was the Henness Pass Road. Cities like Marysville and Nevada City realized that if they were to obtain their share of the rapidly increasing Washoe trade they must build a good wagon road to tap the region. The Truckee Turnpike Co. was organized in November, 1859, to build a road through Henness Pass to connect with an existing road from Marysville to North San Juan via Bridgeport. This road, which would follow the route of the immigrant road down the Pliocene Ridge, was supported by the citizens of Marysville.

A meeting was held by citizens of Nevada City on December 3, 1859, to promote the construction of a road from that city up the San Juan Ridge and through Henness Pass. The Henness Pass Turnpike Company was an outgrowth of that meeting and by the following June it had constructed a road to Jackson's Ranch on the Middle Yuba. Here they joined the road of the Truckee Turnpike which had also reached that point. An agreement was reached and the two companies united in building the road on through the pass toward Virginia City. It was stated at the time: "It must be remembered that the route was already traversed by an imperfect road which was made by the immigrants hauling their wagons over it, with occasional slight improvements from settlers or persons having hay ranches along it."

Placerville Road

Although the Henness Pass Road was used a great deal, both by stages and by freight teams, the bulk of the traffic used the Placerville Road. "Q. S." writing for the Sacramento Union in July, 1864, said that the Henness Pass Road was a mixture of good and bad—"excellences and abominations mixed like hash." The summit was an easy one but there was too much up and down along the way. Of course, when a citizen of Nevada City, say, made a trip over the Placerville Road and wrote about it, the reader would be led to believe it barely passable —at least in comparison to the Henness Pass Road.

Another rival of the Placerville Road was the Amador and Nevada Wagon Road. A bond issue to cover the cost of this road failed to carry in 1861 but when submitted again in May, 1862, it was approved. A franchise was granted to eight citizens of the county to build the road and collect tolls thereon. Bonds paying 12 percent interest were issued and a road 16 feet wide with a maximum grade of 18 percent was to be constructed by October, 1862. The road was to start at Antelope Springs (about 25 miles east of Jackson on Sign Route 88), to which point a road was already constructed. The location of the wagon road was, except for local improvements, the same as that of the present state highway which instead of turning south at Twin Lakes and climbing another thousand feet to cross the Carson Spur as the immigrant road did, is built around the rocky point of the spur at an elevation of about 8,000 feet. Passing Silver Lake it meets the immigrant road again on the ridge just east of Tragedy Springs.

The wagon road reached Silver Lake in August, 1862, and was ready for through travel by the end of that year. The hauling to Washoe of fruit and produce raised in the county and lumber from mills along the road created quite a bit of traffic. However, little traffic was diverted from the Placerville Road which, probably because of its relatively lower elevation and freedom from heavy snows, maintained its leadership over competing roads.

Start on U. S. 40

In view of the present day importance of U. S. 40 the reader may wonder at the failure to include it with the important stage roads described so far. Immigrants had continued to use the route as it suited their convenience or fancy. As early as 1860 a survey for a wagon road was made by one S. G. Elliott and in March, 1861, the Lake Pass Turnpike Company was organized. But it was not

until officials of the Central Pacific Railroad saw the advantages of building a turnpike out ahead of their track that things began to happen.

They formed the Dutch Flat and Donner Lake Wagon Road Company which completed a few miles of road in the fall of 1862. Work was resumed the following June but snow in November prevented completion of the work that year. The road was opened to traffic in June, 1864, and on July 16th the California Stage Company began operating stages over it from the end of the railroad at Clipper Gap to Virginia City.

The first rail on the Central Pacific was laid in Sacramento on October 27, 1863. Although progress was slow for a time, by September, 1865, the track had been laid to Illinoistown, which then became Colfax. By this time the combined railroad and toll road was getting a large part of the trans-Sierra traffic. In November, 1866, the railroad had reached Cisco, which was to remain the rail terminus until the summit tunnel was completed in 1869, and traffic on the great Placerville Road, as well as its rivals, dwindled to but a small part of the previous volume.

Pacific Turnpike

Other roads were built that connected with the Dutch Flat and Donner Lake Wagon Road. Construction was started in May, 1863, on the "Pacific Turnpike" by Culbertson. Connecting with the Donner Lake Road at Emigrant Gap it descended into Bear Valley, crossed the South Fork of the Yuba and joined the Henness Pass Road at Bowman's Ranch (now Bowman Lake). In Bear Valley it was joined by a road, owned by the same company, which came up the Washington Ridge from Nevada City and is now part of Sign Route 20. The "Culbertson Grade" and the road through Henness Pass are now unsurfaced county roads having very light traffic. However, it is said that these roads for a few years after their opening to traffic in May, 1864, handled quite a bit of transmountain business.

The driving of the last spike at Promontory, Utah, on May 10, 1869, may be said to mark the end of stage road supremacy as a means of transportation across the Sierra. The railroad was king. Of course, stage roads still did business to points not reached by the railroad or its branch lines. For example, in 1874 Truckee had become quite a stage center according to Thompson and West's History of Nevada County. It had several daily and tri-weekly stage lines running to Tahoe City, Donner Lake, Sierra Valley and to Graniteville on the San Juan Ridge (then known as Eureka South). Other examples of stage lines were those from Marysville to Nevada City along a portion of Sign Route 20, from Marysville to North San Juan along the present county road through Bridgeport and French Corral, from Nevada City to Dutch Flat, and from Nevada City to Graniteville. Business on such roads was either local in nature or the roads were feeders for the great transcontinental railroad.

Sonora-Mono Wagon Road

There were trans-Sierran roads, however, which at least for a time served areas on the east side of the mountains that were not served by the railroad. The Sonora-Mono Wagon Road, which has become Sign Route 108, was built to reach the Esmerelda mining district, of which Aurora and the perhaps more notorious Bodie were the chief towns.

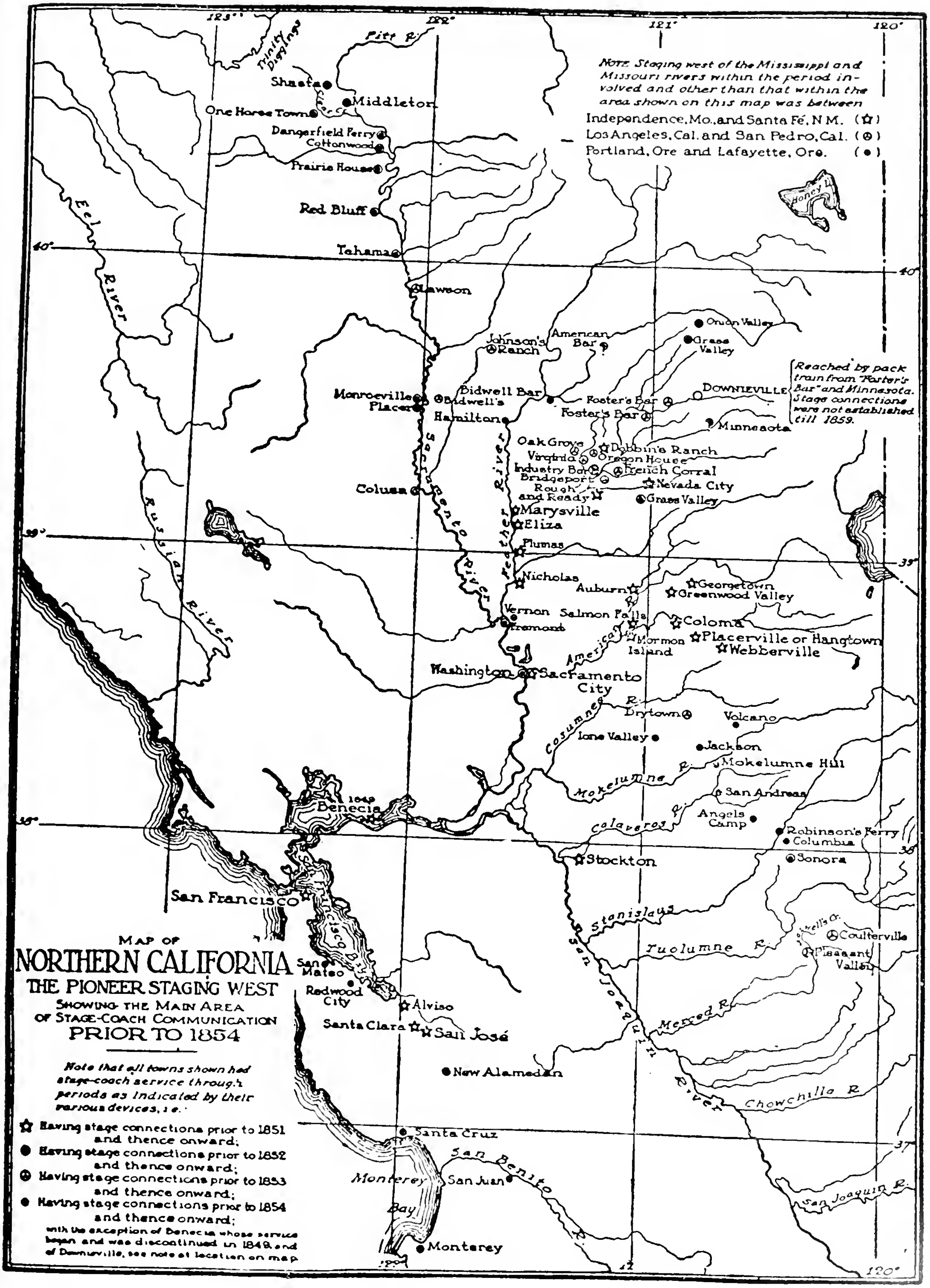
Started in 1861 with funds raised by a bond issue it was intended to be a free road. However, the money was all spent on the portion of the road over the summit and, as in the other cases previously mentioned, a franchise for a toll road was granted. The road was to join existing "good" roads from Sonora to Strawberry and between Aurora and Hot Springs (Fales Hot Springs on U. S. 395). Financial troubles delayed the completion of the road. It was reported in May, 1864, that the company building the road had forfeited its franchise but in August work was being prosecuted with the aid of Bridgeport and Aurora. During this time the stage line used pack animals on what was known as the "Sonora Trail," which followed the Clarks Fork of the Stanislaus instead of the Middle Fork and Deadman Creek like the present highway does. The trail crossed the summit at the same place as the present road whereas the "Sonora Emigrant Road" had crossed several miles farther to the south on an entirely different route between Strawberry (near Pinecrest) and Leavitt Meadows. The stage road was not opened for wagons until after 1870 and traffic, which was never very heavy, declined with fortunes of the Esmerelda district and also as better roads were built to connect that district with the railroad in Nevada.

Oroville-Susanville Route

Turning now to stage roads built in the sixties to reach Susanville and the silver mines of Humboldt and Idaho, roads originating in Oroville, Chico and Red Bluff took on considerable importance. It will be recalled that the first stage over the mountains from Oroville to Susanville traveled by way of Humbug Valley to Nobles Road at the head of Susan River. Later on, traffic used the route from Big Meadows (Lake Almanor) through Mountain Meadows and Fredonyers Pass along the present Sign Route 36.

The Legislature passed an act in April, 1863, granting a franchise to John Bidwell and others to construct a toll road from Chico to Honey Lake. They incorporated as the Chico and Humboldt Wagon Road Company and started work in the spring of 1865 on what is now known as the "Humboldt" Road. The older "Humbug" Road was a little to the south of it at a generally higher elevation and the Humboldt Road being better maintained as well as freer from snow in the winter drew most of the traffic. The portion of the latter road from Chico to Lomo is now a part of Sign Route 32, a modern highway along Deer Creek having been built from that point on to Lake Almanor. A contract was granted in 1866 to haul mail between Chico and Boise, Idaho, via the Humboldt Road. From Honey Lake the route followed Nobles Road to Black Rock and the Quin and Owyhee Rivers to Idaho. Staging and freighting through Susanville became heavy.

The road from Red Bluff, along what is now Sign Route 36, having been completed at the same time as the Humboldt Road, a daily stage operated between Susanville and that town as well as Chico, Oroville and Virginia City. All this caused a local paper to remark: "* * * Susanville—a town which by reason of these discoveries, and its situation on the great thoroughfare leading from California to Black Rock, Idaho, Montana and Humboldt, bids fair to


MAP OF
NORTHERN CALIFORNIA
THE PIONEER STAGING WEST
SHOWING THE MAIN AREA
OF STAGE-COACH COMMUNICATION
PRIOR TO 1854
Note that all towns shown had stage-coach service through periods as indicated by their various devices, i.e.
Having stage connections prior to 1851 and thence onward;
Having stage connections prior to 1852 and thence onward;
Having stage connections prior to 1853 and thence onward;
Having stage connections prior to 1854 and thence onward;
with the exception of Benecia whose service began and was discontinued in 1849, and of Downieville, see note at location on map
NOTE. Staging west of the Mississippi and Missouri rivers within the period involved and other than that within the area shown on this map was between
Independence, Mo., and Santa Fé, N.M.
Los Angeles, Cal. and San Pedro, Cal.
Portland, Ore and Lafayette, Ore.
Reached by pack train from "Foster's Bar" and Minnesota. Stage connections were not established till 1859.
123°
122°
121°
120°
40°
39°
38°
37°
Trinity Diggings
Pitt R.
Shasta
Middleton
One Horse Town
Dangerfield Ferry
Cottonwood
Prairie House
Red Bluff
Tehama
Lawson
Eel River
Honey L.
Orion Valley
Grass Valley
American Bar
Johnson's Ranch
Bidwell Bar
Downieville
Foster's Bar
Minnesota
Monroeville
Placer
Bidwell's
Hamilton
Oak Grove
Dobbin's Ranch
Virginia
Oregon House
Industry Bar
French Corral
Bridgeport
Rough and Ready
Nevada City
Grass Valley
Colusa
Sacramento River
Feather River
Marysville
Eliza
Plumas
Nicholas
Russian River
Auburn
Georgetown
Greenwood Valley
Vernon
Fremont
Salmon Falls
Coloma
American R.
Mormon Island
Placerville or Hangtown
Webberville
Washington
Sacramento City
Cosumnes R.
Drytown
Volcano
Ione Valley
Jackson
Mokelumne Hill
Mokelumne R.
San Andreas
Calaveras R.
Angels Camp
1849
Benecia
Robinson's Ferry
Columbia
Sonora
Stockton
San Francisco
Stanislaus
Tuolumne R.
Coulterville
Pleasant Valley
San Joaquin River
San Mateo
Redwood City
Francisco Bay
Alviso
Santa Clara
San José
Merced R.
New Almaden
Chowchilla R.
Santa Cruz
San Benito R.
Monterey
San Juan
Monterey Bay
San Joaquin R.

become, next to San Francisco, the most important town on the Pacific Coast."

Coming of Central Pacific

The Central Pacific by the following year (1867) had laid its track almost to Winnemucca, thus directly serving the Humboldt mines and cutting in half the length of the stage route to Idaho. All the business was diverted to the railroad and the glowing hopes for Susanville did not materialize.

Time and space does not permit of covering in detail the other roads by which it was possible to cross the Sierra. These included the road from Oroville through Quincy to Beckwourth Pass—for a long time the route of the "Feather River" highway, from Marysville through La Porte, from Nevada City through Downieville and Yuba Pass to Beckwourth Pass or to Truckee, and from Murphys over Ebbetts Pass to Silver Mountain and Markleeville. All of these had their periods of importance and their story is equally as interesting as that of more important roads. Following the completion of the transcontinental railroad, such roads, as well as the great thoroughfares like the Placerville Road, carried only "local traffic." Thirty or more years were to pass before the advent of the automobile was to turn the limelight on any of them.

First State Highway

The growth of the modern automobile highway system is a separate story and just a few of the highlights concerning the roads across the Sierra will be mentioned. The first indication of a new era was an act, approved March 26, 1895, creating the "Lake Tahoe State Wagon Road" which included the Placerville Road from the junction of the Newtown and Placerville Roads near Smiths Flat to the Nevada line. Tolls had been collected from users of this road until the rights were purchased by El Dorado County and it was declared a public highway in 1886. With the signing of an indenture dated February 28, 1896, it became the first state road in California.

The first work, done on this road, other than ordinary repairs, was the construction of an 80-foot stone arch over the South Fork at Riverton with the necessary approaches completed in 1901. Within the next several years culverts and small bridges had replaced the original primitive log bridge or brush and log fills in the watercourses. Large arch culverts were built at Oglesby Canyon and at Trout Creek.

New Era for U. S. 50

Dust on the westerly portion of the road was a serious drawback and so, about 1910, funds were obtained to sprinkle the road in summer, a procedure that had caused Richardson, Bowles and others to laud the condition of the stage road when they passed over it in 1865. In general, progress in improving the road with the exception of the bridges at Riverton and elsewhere, was slow—almost negligible by present day standards. However, the incorporation of the road into the State Highway System in 1917, as a portion of Route No. 11, marked a change in highway thinking. The road was no longer a personal and separate responsibility, it became part of a state road system subject to engineering supervision.

Beginning with a day labor job of placing a 15-foot asphalt macadam surfacing between Five-Mile House and Camino in 1923, the road has been continually improved in keeping with the large volume of both summer and winter traffic which now uses it. It would be hard to say on what part of the road the improvements have been of greatest benefit but it seems safe to say that the most noteworthy changes have been the new roads replacing the old Meyers Grade on the east side of the summit and the Slippery Ford Grade between Strawberry and Camp Sacramento.

Sonora-Mono Toll Road

In 1901, the Legislature made that portion of the "Sonora and Mono" Toll Road (Sign Route 108) between Long Barn and Bridgeport a state highway—but appropriated no funds for its maintenance or improvement. The report of the Department of Highways states: "The 61 miles of this road from Long Barn to the junction was, in July 1901, in a very bad state of repair; the 22 miles over the granite formation was nothing more than a creek bed, while all the bridges on the route were either in a rotten condition or else fallen down."

Beginning in 1905 the Legislature appropriated $4,000, and later $6,000 annually for maintenance of the road and set up $20,000 for improvements. Seven years after it was reported that it was now "fit for travel in the summertime" and 20 years thereafter minor improvements and maintenance had made it a reasonably safe and passable mountain road. Then came the complete reconstruction of the road eastward from Sonora, which has resulted in a modern highway being built as far as the old Patterson Grade. Although the steep grades over the summit are still a trial to many motorists, the road in its present state is a far cry from the agony of navigating the Q' de Porka or of climbing the "Golden Stairs" still within the memory of many motorists.

Tioga Pass Road

While the completion of the Tioga Road across the Sierra was a comparatively recent event, the road is deserving of brief mention. Following an appropriation by the Legislature in 1899 for the construction of a free wagon road connecting Mono County roads with the Tioga Road in Yosemite National Park west of the summit, studies of possible passes over the summit were made. A toll route through Mono Pass and down Bloody Canyon, following the old pack trail, was first given consideration. However, further studies resulted in the adoption of the route through Tioga Pass and down Leevining Canyon and work was started late in the summer of 1902. Construction progress was slow.

In 1910 the road had not been completed to the satisfaction of the State, tolls were still being charged on the old road through the park and automobiles were not permitted in the park. However, through the efforts of Stephen T. Mather of the National Park Service with the cooperation of State Engineer McClure the toll road was purchased, a considerable amount of improvement was done and various difficulties overcome so that Mather could report to the Sierra Club by the end of 1915 that: "The end of next season should make the Tioga Road a perfect mountain highway, with grades that any car of moderate power can negotiate, and scenery

along the route that will be the equal of any in the land." Continued improvement has made the road more and more popular with tourists and campers.

Added to State System

Certain roads in the mountain regions of El Dorado, Amador, Alpine, Calaveras and Mono Counties, built or acquired by these counties, were created state highways by the Legislature in April, 1911. They included the roads through Luthers, Carsons and Ebbetts Passes and through the West Walker Canyon. The northerly limit was Osgoods Station at the foot of the Meyers Grade; the southerly limit was the junction of U. S. 395 and Sign Route 108. The easterly terminals were Jackson and the Calaveras Big Trees. Early work consisted only of general maintenance done without general supervision or planning. Later on small contracts and a great deal of minor improvements and heavy maintenance transformed these roads into comfortable if not always high-speed highways.

Funds for U. S. 40

Once more the history of U. S. 40 trails behind that of the other roads across the Sierra. Not until March, 1909, did the Legislature see fit to appropriate funds for the location, survey and construction of a state highway from Emigrant Gap through Truckee Pass (Donner Summit) to the west end of Donner Lake. The State Engineer, on taking over the road, reported it was in such abominable condition that you could scarcely call it a road. It will be evident that this portion of the Dutch Flat and Donner Lake Wagon Road being located parallel to the tracks of the Central

Pioneer State highway engineers constructed a route, now U. S. 40, over these granite heaps between Emigrant Gap and Donner Summit

LEFT—This is how U. S. 40 looks today at about same spot as shown in photo above. RIGHT—This picture shows present highway on left and old route on right east of Emigrant Gap.

Pacific Railroad had little excuse for being maintained after the railroad was completed.

The first work done was to try to make the road passable throughout, and to improve the drainage in order to reduce the damage from the winter snows as much as possible. A blind railroad crossing through the snow sheds at the mouth of the summit tunnel with its 22 percent approach grade received unfavorable comment in the early reports. Like the other mountain roads minor repairs and improvements were the rule until the law placing a tax on gasoline boosted highway construction.

Victory Highway

It was natural that the Placerville road which had continued to serve for a much reduced stage and freight traffic during the "dark age" of roadbuilding preceding the automobile era should receive first attention. The fact that it was chosen as the route of the transcontinental "Lincoln Highway" added to its importance. However, the better condition of the "Victory Highway" through Utah, its more favorable grades along the Humboldt and the growing importance of Reno and other towns along the route brought about pressure to improve the Truckee River route. Starting in immediately after 1924, major reconstruction and relocation of the existing highway has been continuous but has hardly kept pace with its growing importance.

The first construction work of importance was the grading of a new highway on the east side of the summit which replaced the steep and rocky grade of the wagon road. This work done in 1923 was followed by a relocation of the road west of the summit as far as Soda Springs which replaced the old winding road with a narrow subway under the Southern Pacific Co.'s track. This subway had replaced the treacherous grade crossing mentioned above.

Yuba Gap-Emigrant Gap Route

In 1929 a highway through Yuba Gap between Emigrant Gap and the Big Bend Ranger Station was graded, doing away with the old wagon road which climbed over Bear Trap Summit and passed by Crystal Lake. Two dangerous grade crossings through the snow sheds were eliminated by the relocation. The abandoned portion of the old road between Crystal Lake and Cisco Flat is still visible to the motorist speeding along the highway on the opposite side of the South Fork of the Yuba River. Relocation of the highway along the Truckee River with the abandonment of the old route via the Dog Valley Grade has already been mentioned. These are the major deviations from the route of the old wagon road although there are many places where one can observe the old road weaving back and forth across the new. However, even the old stage road is a far cry from the immigrant road that pitched down into Bear Valley at Emigrant Gap, climbed the ridge to the north of Bear River and followed its undulating crest only to slide down again into Steep Hollow.

Many such scenes are visible to the motorist riding on the present-day highways. To one who will trouble to learn the geography of the country through which he travels and something of its history the trip can become an adventure instead of a duty. Nowhere is this more true than in riding over the roads across the Sierra.

Chapter XII

The Story of Marlette

In these days when the people of California contribute millions of dol lars in gas taxes for construction and naintenance of highways, it is rather dif- icult to visualize the situation that con- ronted the State's first road builder, Sur- eyor General S. H. Marlette, who, in 1855, was forced to advertise in the Sac- amento newspapers for a loan of $500 to inance a survey ordered by legislative ict for the Emigrant Wagon Road over he Sierra by way of Placerville to Carson Valley, Nevada.

At the first session of the Legislature n 1850, before California had been ad- nitted to the Union, a law was passed lefining the duties of the Surveyor Gen- eral. As a member and ex officio Chief Engineer of the Commission of Internal Improvements, he was required **"to make plans and suggestions for im- provements of navigation, construc- tion of roads, railroads and canals, preservation of forests, * * * and sur- veys of boundaries of the State and counties."**

An Ambitious Project

Public agitation for a "post road, or other road, from the Sacramento Valley o the Missouri River, by way of Great Salt Lake," resulting in mass meetings of citizens in San Francisco, Sacramento, Marysville, Placerville and other places n 1854 and 1855, finally culminated in he Legislature taking action.

It passed a bill creating a commission o consist of the Governor, Secretary of State and Surveyor General, which body vas authorized to call for bids for the onstruction of a wagon road from the alley of the Sacramento over the Sierra o Carson Valley at a cost not to exceed 105,000. Governor Bigler signed the neasure April 28, 1855.

The act provided:

"The Surveyor General of the State hall cause to be surveyed a good vagon road over the Sierra Nevada

Old woodcut picture of Emigrant Wagon Toll Road in 1865 from Albert D. Richardson's book "Beyond the Mississippi," published in 1867 illustrating his description of a trip in a six-horse coach from Lake Tahoe to Placerville

Mountains at an expense not to exceed $5,000; and no further liability shall be incurred for this purpose."

No Funds Provided

Through an oversight, the Legislature failed to appropriate any money for a survey of proposed routes.

Poor Marlette was left with a survey on his hands and no money with which to make it.

In desperation he called upon public-spirited citizens for help. He wrote in one of his official reports:

"On the seventeenth of August, 1855, finding it impossible to comply with the requirements of the Wagon Road Act, in a mode commensurate with the importance of the same, in the vain hope of obtaining assistance from some ardent friend of the road, the following advertisement was inserted in Sacramento papers:

" 'Wanted immediately, on the credit of the State, $500 to enable the undersigned to complete the explorations for the Emigrant Wagon Road. Any gentleman who is willing to advance the above-named sum and will signify the same, will be called upon immediately by the undersigned.

S. H. MARLETTE
Surveyor General'."

"Two gentlemen," General Marlette recorded, "called to inquire what security could be given for the above-named amount to which I replied: 'The justice and liberality of the next Legislature'."

The Surveyor General then appealed to the people of Sacramento, El Dorado and Calaveras Counties for subscriptions to make a survey and funds were raised for the purpose. Marlette commissioned State Senator Sherman Day, a well-known engineer, to locate a route for the Emigrant Road over the Sierra to Carson Valley and Day began his task on June 11, 1855.

He completed a preliminary survey and returned to Sacramento whereupon Marlette set out with him to make a second survey. Day favored a route which today is the course of the state highway from Sacramento through Placerville to Lake Tahoe (then called Bigler Lake), thence into Carson Valley, Nevada. Later, General Marlette directed George H. Goddard, grandfather of Al Goddard of Sacramento, to make a third investigation.

With the information gathered by his engineers, Marlette and the Wagon Road Commissioners advertised for bids for the work of building the road and a contract was awarded to L. B. Leach of Stockton. Subsequently it was found that Leach was a fictitious person and the charge was made that enemies of the proposed road had connived to submit an exceptionally low bid in order to delay construction.

Declared Unconstitutional

Meanwhile, the State Controller refused to audit accounts under the Wagon Road Act and Marlette and those who had contributed money for the surveys were out of pocket. Their claims remained unpaid until April 30, 1857. The Controller later was sustained, the Supreme Court in December, 1856, declaring the Wagon Road Act unconstitutional.

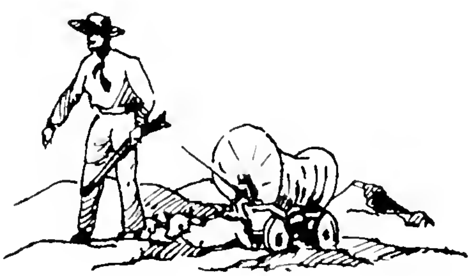
With the legality of the statute questioned, the citizens of Placerville in June, 1856, voted $5,500 for a road from there to Carson Valley over the Day-Marlette route. In February, 1857, President Pierce approved a congressional appropriation of $300,000 for a wagon road from Fort Kearney, via South Pass of the Rocky Mountains and Great Salt Lake Valley to the eastern boundary of California, near Honey Lake.

Immediately, Californians set to work to raise funds for a road over the Sierra to meet the projected federal road at Honey Lake. On May 11, 1857, representatives of Sacramento, El Dorado and Yolo Counties met in Sacramento. Twenty thousand dollars were subscribed by Sacramento, an equal amount by El Dorado and $10,000 by Yolo. The Day route was approved.

Finally, in November, 1858, the road linking Sacramento and Placerville with Carson Valley was completed.

Lack of legislative support for the Emigrant Road and opposition by interests involved in building the first transcontinental railroad resulted in the road being taken over by private capital following the discovery of great silver deposits in Nevada and the excessive traffic from Sacramento over the Sierra to the Comstock and other Nevada mines. The route became a toll road and paid huge dividends to its operators.

Years later, in 1895, when the Legislature created the State Bureau of Highways, the old pioneer toll road, known as the Lake Tahoe Wagon Road, was taken over by the State, thus becoming the starting point of the vast California Highway System of today.



Chapter XIII

Start of Highway System

By KENNETH C. ADAMS, *Editor*

THE STORY of the Division of Highways of the Department of Public Works has its beginning back in 1895. In that year California, by act of the Legislature, created the State Bureau of Highways and acquired the Lake Tahoe Wagon Road, a pioneer toll road, as the first state highway. From this humble start there has developed the California State Highway System which totals some 14,000 miles and serves every section of the State with paved public thoroughfares.

Over the 65 miles of the historic Lake Tahoe Wagon Road from Smiths Flat at Placerville to the state line, east of Meyers, had flowed the variegated traffic of early California. It was typical of the main highways along the Pacific slope prior to the advent and rise of railroads, when the thoroughbrace stages and high-wheeled freighters of the Pioneer Stage Line required 50 men and 600 horses for the service between Placerville and Carson and Virginia Cities. In the year 1862, thirty thousand tons of freight and 36,500 passengers traveled this mountain road with an estimated yearly business for the operating company of more than $4,000,000.

In 1896 Commissioners R. C. Irvine and F. L. Maude of the newly created Bureau of Highways purchased a buckboard and team of horses and traveled seven thousand miles, mapping out a state highway system. Maje, Irvine's Gordon setter, made the entire trip

Highway Pioneers

Under the Act of 1895 the Governor was empowered to appoint three members of the Bureau of Highways and he named R. C. Irvine, Sacramento; Marsden Manson, San Francisco, and J. L. Maude, Riverside.

These officials purchased a team of horses and a buckboard wagon. During 1895 and 1896, Irvine and Maude drove into every county of the State, covering 7,000 miles along the coast, through valleys, mountains and deserts, and on November 25, 1896, submitted to the Governor a report recommending a system of state highways "traversing the great belts of natural wealth which our State possesses, connecting all large centers of population, reaching the county seat of every county and tapping the lines of county roads so as to utilize them to the fullest extent."

During the first year the three commissioners traveled over the following distances: Irvine, 3,000 miles; Manson, 2,818; Maude, 1,950. During the second fiscal year, the State was districted, Irvine traveling over the northern portion, covering 3,500 miles; Manson over the central portion, covering 4,262 miles; and Maude over the southern portion, covering 1,300 miles.

Accompanying their report was a map of a proposed State Highway System which in its main features was the foundation of the system as it exists today.

Highway System Recommended

In that early report Irvine, Manson and Maude said:

"Guided by the principles necessary to be considered and the conditions presented, the bureau has mapped out a system of state highways, outlined upon the relief map of the State in the office of the bureau. This map, which shows at a glance the topographical features of the State, was secured in the belief that its use would result in a better understanding of the problems which the bureau is expected to solve, point out more clearly the errors incidental to our present system, particularly the defect of faulty location of roads, and demonstrate the breadth and scope of the plan recommended. Upon it have been represented all the important roads now in existence

Sketch Map

—OF—

California.

OUTLINING THE STATE HIGHWAY SYSTEM

RECOMMENDED BY

THE BUREAU OF HIGHWAYS.

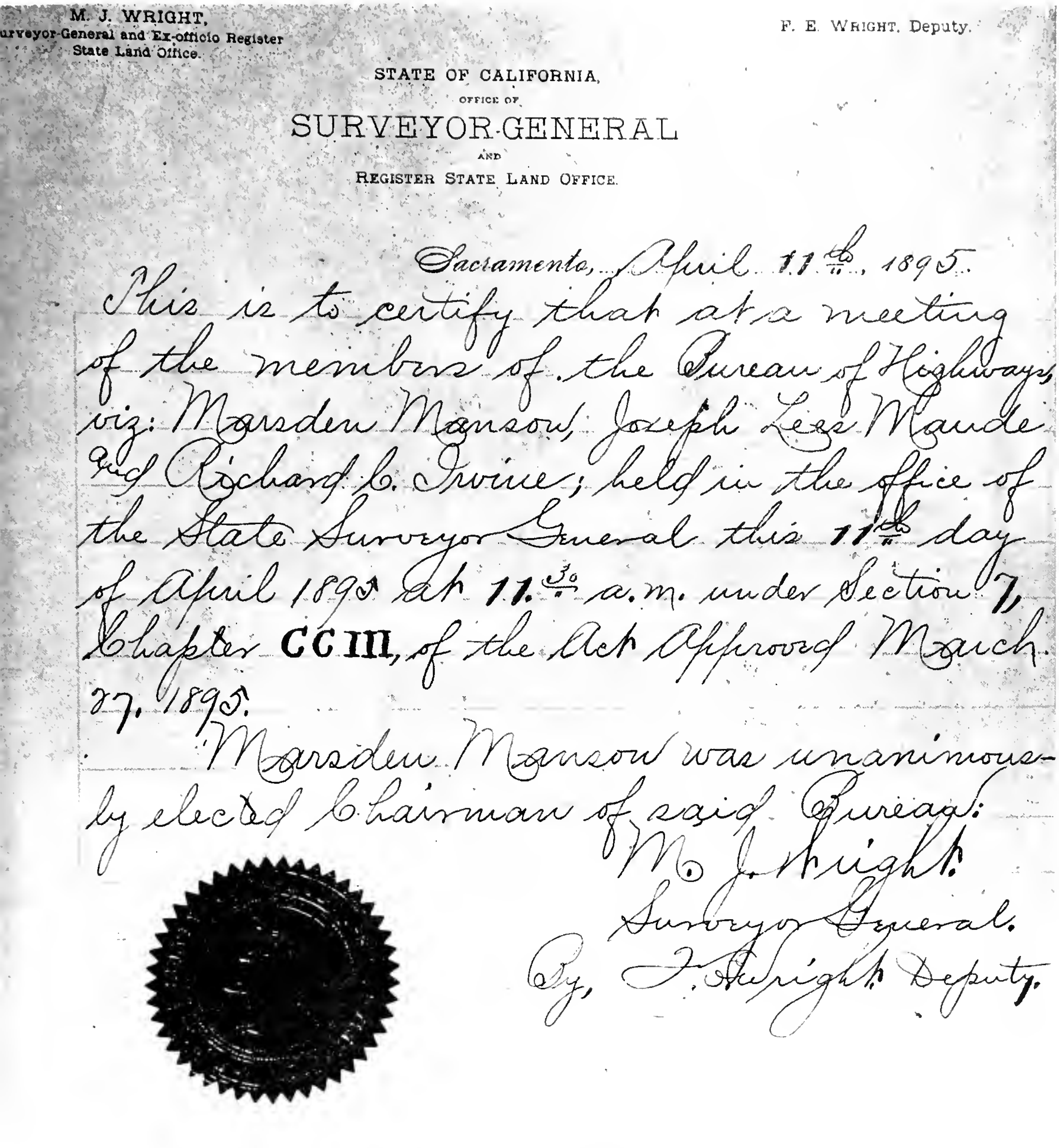
State and County Boundaries, Etc., Shown in Black.
Highway System in Red.

Prepared in the office of the Bureau of Highways

J. H. WATKINS, DEL.

THIS system intersects the great belts of wealth in the State, traverses every county, reaches every county seat and all centers of population, and is projected on the best grades possible.

Note. This is a reproduction of the map prepared by the Bureau of Highways in 1896 showing the State highway system they recommended. Original map was in two colors.



M. J. WRIGHT,
urveyor-General and Ex-officio Register
State Land Office.

F. E. WRIGHT, Deputy.

STATE OF CALIFORNIA,
OFFICE OF
SURVEYOR-GENERAL
AND
REGISTER STATE LAND OFFICE.

Sacramento, April 11th, 1895.

This is to certify that at a meeting of the members of the Bureau of Highways, viz: Marsden Manson, Joseph Lees Maude and Richard C. Irvine; held in the office of the State Surveyor General this 11th day of April 1895 at 11.30 a.m. under Section 7, Chapter CCIII, of the Act Approved March 27, 1895.

Marsden Manson was unanimously elected Chairman of said Bureau.

M. J. Wright.
Surveyor General.
By, F. Wright, Deputy.

Photograph of minutes of first meeting of Bureau of Highways held in Sacramento on April 11, 1895

d the proposed system of state highys.

From Oregon Line

"The highways mapped out are as lows:

"1. A highway, commencing on the line between the State of California and the State of Oregon, at or near the point where said state line is intersected by the road from Yreka, California, to Ashland, Oregon, and extending thence southerly, along the best grades and alignments, through the Counties of Siskiyou, Shasta, Tehama, Butte, Yuba, Sutter, Sacramento, San Joaquin, Stanislaus,

Merced, Madera, Fresno, Tulare, Kern, Los Angeles, and San Diego, to Tia Juana.

"2. A highway commencing at Crescent City, in Del Norte County, and extending thence south and southeasterly, on the best grades and alignments, through the Counties of Del Norte, Humboldt, Mendocino, Sonoma, and Marin, to Sausalito.

"3. A highway, commencing in the City and County of San Francisco, and extending thence southeasterly, on the best grades and alignments, through the Counties of San Mateo, Santa Clara, San Benito, Monterey, San Luis Obispo, Ventura, and Los Angeles, to the City of Los Angeles.

Northern California Routes

"4. A highway, commencing at a point on the state highway through Tehama County, at or near the station of Tehama, and extending thence southerly, on the best grades and alignments, through the Counties of Tehama, Glenn, Colusa, Yolo, and Solano, to Vallejo.

"5. A highway, commencing at the City of Martinez, and extending thence southeasterly, on the best grades and alignments, through the Counties of Contra Costa, Alameda, San Joaquin, Stanislaus, Merced, Fresno, Kings, and Kern, to a point on the state highway through Kern County, at or near Bakersfield.

"6. A highway, commencing at a point on the state highway through Shasta County, near the westerly base of Mount Shasta, and extending thence southeasterly, on the best grades and alignments, through the Counties of Siskiyou, Shasta, Lassen, Plumas, Sierra, Nevada, El Dorado, Alpine, Mono, Inyo, and Kern, to Indian Wells, in the last-mentioned county.

Mountain Routes

"7. A highway, commencing at Arcata, in Humboldt County, and extending thence southeasterly, on the best grades and alignments, through the Counties of Humboldt, Trinity, and Tehama, to a point on the state highway through Tehama County, at or near Red Bluff.

"8. A highway, commencing at a point on the state highway through Shasta County, north of Redding, and extending thence northeasterly, on the best grades and alignments, through the counties of Shasta, Plumas, and Modoc, to Fort Bidwell, in the last-mentioned county.

"9. A highway, commencing at the City of Marysville, and extending thence northerly and northeasterly, on the best grades and alignments, through the counties of Yuba, Butte, Plumas, and Lassen, to Susanville, in the last-mentioned county.

Lateral Highways

"10. A highway, commencing at the City of Ukiah, and extending thence southeasterly, on the best grades and alignments, through the Counties of Mendocino, Lake, and Yolo, to the City of Sacramento; thence easterly, through the Counties of Sacramento and El Dorado, to a point on the state line between the State of California and the State of Nevada, at or near its intersection by the Lake Tahoe wagon road.

"11. A highway, commencing at or near the City of Santa Rosa, and extending thence southeasterly, on the best grades and alignments, through the Counties of Sonoma, Napa, and Solano, to Suisun, in the last-named county.

"12. A highway, commencing at a point on the state highway running north from Sacramento, and extending thence northeasterly, on the best grades and alignments, through the Counties of Sacramento, Placer, Nevada, and Sierra, to a point on the state highway through Sierra County, near Susanville, in the last-mentioned county.

"13. A highway, commencing at the City of Oakland, and extending thence easterly, on the best grades and alignments, through the Counties of Alameda and San Joaquin, to a point on the state highway through San Joaquin County south of the City of Stockton.

"14. A highway, commencing at the City of Oakland, and running thence northerly and easterly, on the best grades and alignments, through t Counties of Alameda and Contra Cos to Martinez.

Through Mother Lode

"15. A highway, commencing at Ior in Amador County, and extendi thence easterly, on the best grades a alignments, through Amador County, Jackson; thence southeasterly, throu the Counties of Amador, Calaveras, a Tuolumne, to Sonora.

"16. A highway, commencing at point on the state highway throu Santa Clara County, at or near Gilro and extending thence northeasterly, the best grades and alignments, throu the Counties of Santa Clara, San Beni Merced, and Mariposa, to the easte line of the state grant, Yosemite Valle

"17. A highway, commencing at point on the state highway through San Clara County, at or near Gilroy, a extending thence southeasterly and ea erly, on the best grades and alignmen through the Counties of Santa Cla San Benito, Merced, and Fresno, to t City of Fresno.

"18. A highway, commencing at M desto, and extending thence northea erly, on the best grades and alignmen through the Counties of Stanislaus a Tuolumne, to Sonora.

Fresno Lateral

"19. A highway, commencing at near Hollister, and extending then southeasterly, on the best grades a alignments, through the Counties of S Benito and Fresno, to a point on t westerly highway through the last-me tioned county, near Huron.

"20. A highway, commencing at point on the state highway through S Luis Obispo County, at or near S Miguel, and extending thence easterl on the best grades and alignmen through the Counties of San Luis Obis and Kern, to a point on the westerly sta highway in the last-mentioned count

"21. A highway, commencing at Pc Harford, in San Luis Obispo Count and extending thence southeasterly a northeasterly, on the best grades a

ılignments, through the Counties of San
Luis Obispo, Santa Barbara, Ventura, and Kern, to Indian Wells, in the last-named county.

Orange Belt Highway

"22. A highway, commencing at the City of Los Angeles, and extending thence easterly, on the best grades and alignments, through the Counties of Los Angeles and San Bernardino, to the City of San Bernardino; thence southwesterly, on the best grades and alignments, through the Counties of San Bernardino, Riverside, and Orange, to Santa Ana, in Orange County.

"23. A highway, commencing at a point on the state highway through Shasta County, north of Redding, and extending thence northwesterly, on the best grades and alignments, through the Counties of Shasta and Trinity, to Weaverville, in the last-named county.

"24. A highway, commencing at Nevada City, and extending thence westerly through the counties of Placer, Yuba, Sutter, and Colusa, on the best grades and alignments, via the Cities of Marysville and Colusa, to a point on the state highway through said last-named county.

Alpine County Route

"25. A highway, commencing at Markleeville, and extending thence easterly, on the best grades and alignments, to a point on the state highway through Alpine County.

"26. A highway, commencing at Mariposa, and extending thence northwesterly, on the best grades and alignments, to a point on the state highway through Mariposa County.

"27. A highway, commencing at Visalia, and extending thence westerly, on the best grades and alignments, through the Counties of Tulare and Kings, to Hanford, in Kings County.

"28. A highway, commencing at a point on the state highway through Alameda County, at or near Niles, and extending thence southerly, on the best grades and alignments, through Alameda and Santa Clara Counties, to San Jose: thence southwesterly, on the best grades and alignments, through the Counties of Santa Clara and Santa Cruz, via the Cities of Los Gatos and Santa Cruz, to a point on the state highway through Santa Cruz County, near Watsonville."

PAST MEMBERS OF THE CALIFORNIA HIGHWAY COMMISSION

Name	Residence	Date of appointment	Termination of membership
Burton A. Towne*	Lodi	Aug. 2, 1911	Resigned Jan. 14, 1914
Charles D. Blaney*	Saratoga	Aug. 2, 1911	Resigned Mar. 1, 1917
N. D. Darlington	Los Angeles	Aug. 2, 1911	Resigned Jan. 8, 1923
Charles F. Stern	Eureka	Jan. 15, 1914	Resigned Dec. 21, 1918
Henry J. Widenmann*	Vallejo	Mar. 1, 1917	Died Oct. 6, 1918
Charles A. Whitmore*	Visalia	Nov. 29, 1918	Resigned Jan. 8, 1923
Emmett Phillips*	Sacramento	Dec. 21, 1918	Died June 18, 1919
George C. Mansfield*	Oroville	June 24, 1919	Resigned Jan. 9, 1923
Harvey M. Toy*	San Francisco	Jan. 9, 1923	Resigned Jan. 3, 1927
Louis Everding*	Arcata	Jan. 9, 1923	Resigned Jan. 17, 1927
Nelson T. Edwards	Orange	Jan. 10, 1923	Resigned Jan. 3, 1927
Ralph W. Bull*	Eureka	Jan. 6, 1927	Resigned Jan. 6, 1931
J. P. Baumgartner*	Santa Ana	Jan. 6, 1927	Resigned Jan. 6, 1931
M. B. Harris*	Fresno	April 18, 1927	Resigned Jan. 6, 1931
Joseph N. Schenck	Los Angeles	Aug. 19, 1927	Resigned Jan. 6, 1931
Fred S. Moody*	San Francisco	Aug. 19, 1927	Resigned Jan. 6, 1931
Earl Lee Kelly	Redding	Jan. 6, 1931	Resigned Oct. 18, 1932
Frank A. Tetley*	Riverside	Jan. 6, 1931	Resigned July 31, 1935
Timothy A. Reardon	San Francisco	Jan. 6, 1931	Resigned May 7, 1936
Harry A. Hopkins	Taft	Jan. 6, 1931	Resigned Oct. 14, 1937
C. D. Hamilton*	Banning	Aug. 1, 1935	Died April 24, 1936
Dr. W. W. Barham	Yreka	Dec. 20, 1932	Resigned May 21, 1935
Ray Ingels	Ukiah	May 21, 1935	Resigned Oct. 4, 1935
H. R. Judah	Santa Cruz	May 7, 1936	Resigned Oct. 5, 1937
Philip A. Stanton*	Anaheim	Jan. 6, 1931	Resigned Mar. 3, 1939
Paul G. Jasper*	Fortuna	May 7, 1936	Resigned Mar. 3, 1939
William T. Hart	Carlsbad	July 7, 1936	Resigned Mar. 3, 1939
Robert S. Redington	Los Angeles	Oct. 5, 1937	Resigned Jan. 27, 1939
Frank W. Clark	Los Angeles	Jan. 27, 1939	Resigned Mar. 10, 1939
Lawrence Barrett	San Francisco	Mar. 3, 1939	Resigned Jan. 11, 1943
Jener W. Nielsen	Fresno	Mar. 3, 1939	Resigned Jan. 11, 1943
Amerigo Bozzani	Los Angeles	Mar. 3, 1939	Resigned Jan. 11, 1943
Bert L. Vaughn	Jacumba	Mar. 3, 1939	Resigned Jan. 11, 1943
L. G. Hitchcock	Santa Rosa	Mar. 10, 1939	Resigned Jan. 11, 1943
†Gordon H. Garland	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
†Mrs. Dora Shaw Heffner	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
†Miss Helen MacGregor	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
†Verne Scoggins	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
†William Sweigert	Sacramento	Jan. 11, 1943	Resigned Sept. 14, 1943
C. Arnholt Smith	San Diego	Sept. 14, 1943	Resigned Jan. 1, 1949

* Deceased.
† Member of the Interim Commission.

Original Highway Report

With no crystal bowl to guide them, the original highway commissioners said this in their 1896 report:

"The bureau recognizes that, in the existing industrial conditions, it would not be wise nor just to advocate an increase in the maximum tax rate now authorized for highway purposes. The true way to lessen existing evils is to reduce and equalize the rate of present taxation and to expend economically and wisely the amounts raised. It is therefore recommended:

"1. That the limit of taxation for highway purposes in each county, now fixed by law at 40 cents per $100 of assessed valuation of outside property, be reduced to 35 cents;

"2. That a general state levy of one-quarter of a mill per $1 of assessed valuation be made, the proceeds of which shall constitute a state highway fund for the systematic location, construction, and maintenance of the system of state highways hereinafter outlined.

Highway Tax Minimized

"Under this system every taxpayer in the State will contribute to the construction of these main highways. At present only those owning property outside of incorporated cities are called upon to bear the expenditures on roads; but under the plan recommended those owning property solely in the cities, and who are likewise benefited either directly or indirectly, will bear a slight share in the cost

of this needed improvement. The amount is infinitely small, but the results will be of tremendous advantage to the entire State. The counties will gradually be relieved of the expense of maintaining that portion of the state highways within their limits, thus leaving a larger sum for their county thoroughfares and district roads. These latter, by proper construction, will gradually require smaller expenditures for maintenance, so that the system proposed herein, and found advisable in other states and countries, *will tend to lessen the burdens now endured.*

"Although the system of state highways recommended seems a gigantic undertaking, it is reasonably certain *that it can be built within the next few decades with what can be saved from the present extravagant and wasteful methods.*

Between Hood and Franklin in Sacramento County before first highway bond issue

Highway Department Created

The Legislature of 1897 dissolved the Bureau of Highways and created a Department of Highways, of which Marsden Manson, J. R. Price, and W. L. Ashe were appointed commissioners to serve for two years, at the end of which time their offices automatically should cease and all powers attached to them be vested in one man, "who must be a civil engineer," to be appointed by the Governor and to hold office for four years.

The members of the new Department of Highways bent their efforts in exhaustive studies of road construction practices and economics. Mr. Manson made a tour of Europe to observe the methods followed in England, France, Germany, Russia, and other countries. Their findings on drainage problems, roadbed, and pavement construction were based on fundamental engineering practice so that in its early beginnings modern highway development in California was placed on a firm foundation.

At the close of the two year period of activity of the three commissioners, Mr. J. L. Maude, of the original Bureau of Highways, was appointed to the office of Highway Commissioner.

Highway System Authorized

As the result of the work of these pioneers of modern road construction, an amendment to the California State Constitution was adopted on November 4, 1902, giving the Legislature power to establish a system of state highways and to pass all laws necessary or proper for highway construction and maintenance, and authority to extend state aid to counties for their road systems. Prior to 1902, beginning with the Lake Tahoe Wagon Road, several county roads had been conveyed to the State, and by various legislative acts commissions had been appointed to survey and reconstruct these roads; some bridges also were constructed by the State under the authority of similar legislation, but in all instances each project was an entity in itself.

In 1907 the Department of Engineering was established, consisting of an ad[visory] board composed of the Governo[r], the State Engineer, the Superintenden[t] of State Hospitals, and the chairman o[f] the State Board of Harbor Commissione[rs] in San Francisco. Mr. Nathaniel Eller[y], who, in 1903, had succeeded Mr. Maud[e] to the position of Highway Commi[s]sioner, was appointed to the position o[f] State Engineer by Governor James N. Gillette at the time of the formation o[f] the Department of Engineering. How[]ever, lack of funds prevented any mate[]rial progress of the Department o[f] Engineering in road construction.

Same section of road improved after Sacramento's successful bond issue campaign

SAVINGS FROM GOOD ROADS

In January, 1915, the Secretary of the Sonoma County Good Roads Club wrote to Col. S. H. Finley, County Highway Engineer of Orange County, regarding savings effected by good roads. Col. Finley replied in part as follows:

"In your county the saving on depreciation, repairs and fuel for automobiles will average at least $110 each per year. Assuming that you have 2,000 motor vehicles of all kinds in the county, the savings to the owners of these will annually amount to $220,000.

"Assuming that you have 5,000 horses and mules in your county, the good roads will save at least:

"For shoes and harness annually, $1.50 each	$7,500
"For each animal for feed, 50 cents per month	30,000
"Increase useful life of each animal, 10 percent	75,000
"Wear and tear on wagons and carriages, 2,000 at $5 each	10,000
Total	$122,500."

Good Roads Favored

During these preliminary years of the articipation of the State in road development, favorable public sentiment for good roads" programs was spreading hroughout the Nation and with the apid rise in the manufacture and sale of notor cars during the first decade of the entury this public sentiment crystallized nto action.

First Bond Issue

In 1909 the Legislature passed and the Governor approved an act providing for bond issue of $18,000,000 for the purpose of acquiring and constructing a tate Highway System. The act was submitted to the people at the general lection in 1910 and upon their approval ecame effective December 31, 1910.

This picture with title was used in early bond issue campaign

The Act of 1909 providing for the First State Highway Bond Issue made possible the real beginning of a unified system of state highways. It provided that the system should be acquired and constructed by the Department of Engineering, and the routes selected and laid out so as to constitute a continuous and connected State Highway System running north and south, traversing the Sacramento and San Joaquin Valleys and along the coast, by the most direct and practicable routes connecting the several county seats and joining centers of population, together with such lateral roads as might be necessary to connect the north and south arterials with the county seats lying east and west of such highways, and also to connect with the chief transcontinental routes entering California.

First Highway Commission

In 1911 the Legislature passed an act which added three appointive members to the Advisory Board of the Department of Engineering to serve, with salary, at the pleasure of the Governor. At a meeting of the advisory board in August, 1911, an enabling resolution was adopted which designated the three appointed members as an executive committee, to be known as the California Highway Commission, and which vested in the Commission the actual handling of the work of acquiring and constructing the State Highway System as provided under the bond issue of 1909.

As the three appointive members, Governor Hiram W. Johnson named Burton A. Towne of Lodi, Charles D. Blaney of Saratoga and N. D. Darlington of Los Angeles to serve as California's first active Highway Commission. Mr. Towne served as chairman of the commission.

Funds Limited

Governor Johnson warned the commission, at the first meeting held in his office, that they faced "a tough job." "You are expected," he said, "to build, with $18,000,000, a highway system that some of the best engineers have estimated will cost from thirty-five to fifty millions."

Chairman Towne and his colleagues assumed their responsibilities without hesitation and together with Mr. Austin B. Fletcher, whom Governor Johnson appointed State Highway Engineer, began the task of making surveys and plans and

of beginning construction of the California State Highway System. That the work of these pioneers was well done is evidenced by the world wide renown of the system for which they built the foundation.

This first commission and Mr. Fletcher toured the State from the Oregon line to the Mexican border, traveling 6,800 miles and making an intensive study of the highway needs of the State as a whole, but bearing in mind the stipulations of the bond act for the system.

Seven Districts Established

The physical features of California laid down certain obvious controls for highway route selections, so, on the basis of the earlier studies, their own observations and these geographical controls, a system was adopted and the work of surveys begun in preparation for construction. The State was divided into seven districts, each in charge of competent and experienced engineers, who carried out the commission's policies and pushed the work ahead.

First Contract Started

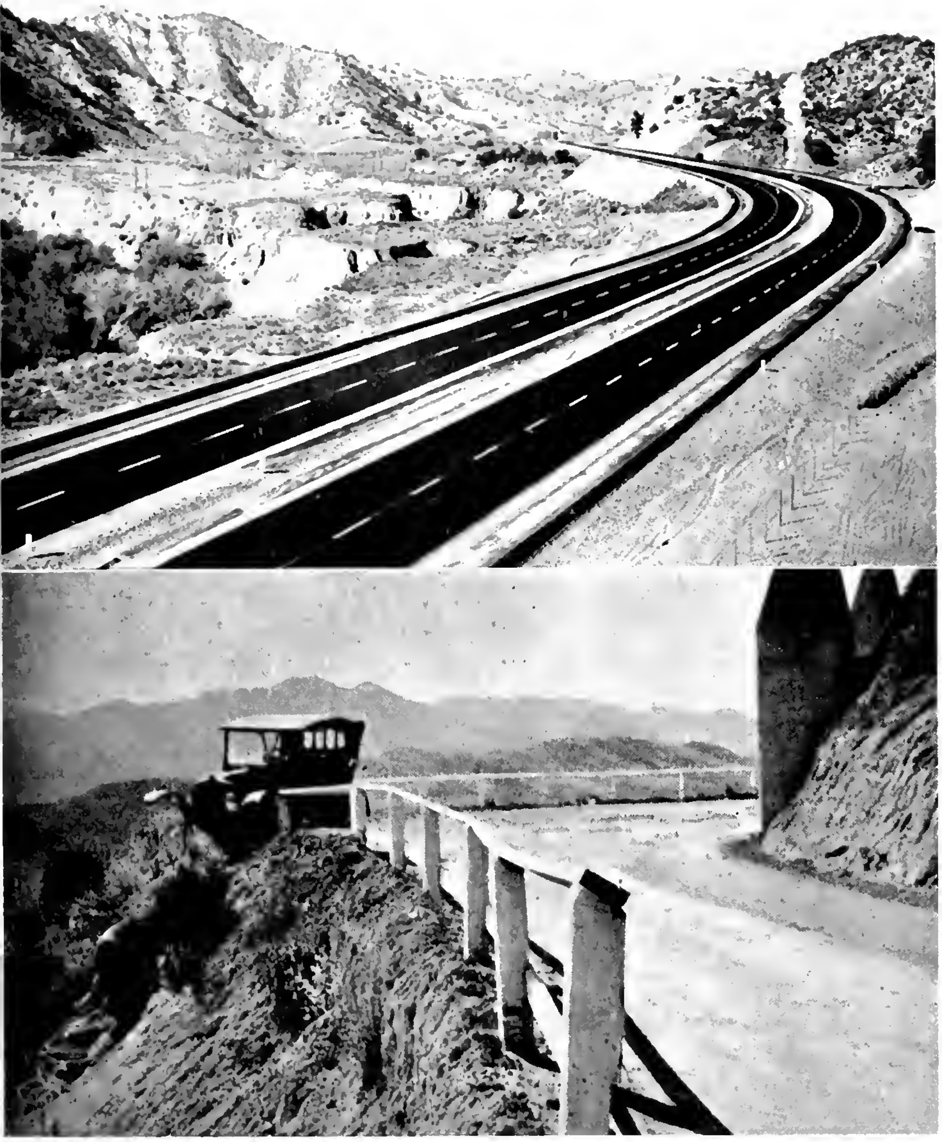
In less than one year after the beginning of work more than 1,000 miles of state highway had been surveyed. On August 7, 1912, Mr. Towne turned the first shovel of earth on California State Highway Contract No. 1, to start construction of an asphalt concrete pavement on a section of the Coast Route between South San Francisco and Burlingame, in San Mateo County. Since that date highway construction, reconstruction, improvement and maintenance have been continuous on the State Highway System.

Of that first commission, Mr. Towne resigned on January 14, 1914, because of the press of private business, Mr.

ROLLER SKATING ON STATE HIGHWAY

Press dispatches report that "skating rinks in San Mateo County are doomed to a natural death, judging from the avidity with which the young folk of the peninsula towns have taken up the fad of utilizing the new state highway for roller recreation. Moonlight skating parties are quite the common thing on the new smooth surface of El Camino Real. A party of young people from South San Francisco skated six miles to Easton one evening, built a big bonfire and served coffee and cake."—*From California Highway Bulletin of May, 1913.*

The start of actual construction work on the State Highway was made in San Mateo County on August 7, 1912. In the group are Chairman Towne of the Highway Commission with shovel; W. J. Martin, South San Francisco; L. E. Aubury, Ex-State Mineralogist; Judge P. E. Lamb, Burlingame; Ex-County Recorder of San Mateo County, H. O. Heiner; Dr. F. C. McGovern; A. E. Ritchie, Fred Cunningham and Supervisor W. H. Brown, San Mateo County



In the lower picture is shown a section of the Ridge Route, U. S. 99, before gas tax funds modernized this mountain highway as shown above

Blaney resigned in March of 1917 on his physician's orders, but Mr. Darlington served until January 8, 1923, a period of more than 11 years and five months. Succeeding commissioners have held to the high standards of public service which these pioneers in state highway development inaugurated.

Maintenance Funds Provided

In 1913 the State Legislature passed an act requiring the registration of all motor vehicles and the payment of a fee for such registration. The act provided for the equal division of the net revenue from such fees between the State and the counties, apportionment to each of the 58 counties to be made in the proportion of the motor vehicle registration in the county to the total registration. From these funds the Highway Commission derived the first money which was available for maintenance activities, as the act provided that the State's half should be devoted to this purpose.

The 1915 Legislature passed an act providing for a second bond issue of $15,000,000. This act, known as the "State Highway Act of 1915" was ratified by the people at the election in 1916 and became effective December 31, 1916. That California had become highway-conscious is attested by the fact that not a single county voted against this issue.

The expenditure of the proceeds from this second bond issue was placed in the hands of the commission for the further development of the State Highway System. The act providing for the second bond issue also added additional mileage to the system.

Funds from the sale of the first $18,000,000 bond issue were exhausted by January, 1917, and funds from the second issue were not available until after July 1, 1917. However, in order that there be no interruption in the work of the Highway Commission, state officials agreed to borrow from the Motor Vehicle Fund sufficient money to tide over the interim.

Commission Statutory Body

The 1917 Legislature gave the California Highway Commission statutory recognition and a legal entity by amending the Department of Engineering Law to provide that the three appointed members of the advisory board should compose a subdivision of the Department of Engineering designated as the California Highway Commission and expressly prescribing its powers and duties. This amendatory act also transferred all state roads which had been constructed under special appropriations and which until 1917 had remained in charge of the State Engineer to the jurisdiction of the Highway Commission.

Thus the California Highway Commission ceased to be an executive committee of the advisory board created for greater convenience in the conduct of the state highway work under the first bond issue and became a statutory body in immediate control and supervision of all state road and highway activities.

Last Highway Bond Issue

At a special election July 1, 1919, the people of California approved a third highway bond issue for $40,000,000. These funds became effective immediately and provided for continued construction of the highways designated by the two previous bond issues. Under this third bond issue additional roads were

In more ways than one, California has established highway records. Since 1911, the State has had only four state highway engineers. Left to right: A. B. Fletcher, 1911-1923; R. M. Morton, 1923-1927; C. H. Purcell, 1927-1943; George T. McCoy, 1943 to present

made a part of the State Highway System.

This was to be the last of the bond issues. In its biennial report for 1919-20, the Highway Commission recommended the imposition of a gasoline tax, the proceeds of which should be devoted solely to highway purposes; however, the gas tax did not come into existence until 1923, but it came to stay.

The Highway Commission in its biennial report for 1921-22 warned that the depletion of the $40,000,000 bond issue rapidly was approaching, that California was faced with the future expenditure of millions of dollars for highways and that the time had come when a new method of financing was necessary. Sentiment was crystallizing in favor of a gas tax as a "pay as you go" method.

Two-Cent Gas Tax Passed

The Legislature of 1921 did not act upon the gas tax proposal, but two years later, at the 1923 Session, a bill for a 2-cent gasoline tax was submitted, passed, and approved by the Governor. This new law provided that 1 cent of the tax was to be used for maintenance and reconstruction of state highways and 1 cent to be distributed among the counties for improvement of county roads.

The 1921 Legislature created the Department of Public Works composed of the Division of Highways, Division of Water Rights, Division of Engineering and Irrigation, Division of Land Settlement and the Division of Architecture.

The act creating this new state department designated the State Highway Engineer as the Director of Public Works and created a Board of Public Works consisting of the director and the California Highway Commission.

CALIFORNIA HIGHWAYS MOST NOTABLE IN U. S.

I have just returned from a 1,000-mile tour of California highways, more than 600 miles of which traversed the state system of trunk lines. With due regard for the great work already completed and under way in the Eastern states, I predict that the California Highway System, now in the making, will be, when completed, the most notable system of highways in America, if not in the world.—*J. E. Pennybaker, Chief of Road Economics, United States Office of Public Roads, in California Highway Bulletin, June, 1916.*

Commission Separate Agency

With the advent of Governor Richardson into office in 1923 the Highway Commission was taken out of the Department of Public Works, becoming a separate state department and taking over all the duties relative to highway work previously performed by it under the Department of Public Works. The State Engineer became the Director of Public Works, relieving the State Highway Engineer who became the executive officer of the commission and handled only highway work.

The Governor on January 9, 1923, appointed a new Highway Commission, with Harvey M. Toy as Chairman and Louis Everding and Nelson T. Edwards as members. Mr. Fletcher having resigned the position of State Highway Engineer to accept a position with the United States Bureau of Public Roads in Washington, Mr. R. M. Morton was named to succeed him.

Under the new commission the mileage of the State Highway System was redistributed and three districts were added to the original seven into which the State had been divided in 1911.

Additional Revenue

During the period from 1923 to 1927 while revenues from the gas tax and vehicle registrations increased rapidly and reconstruction and maintenance activities advanced it became evident that some provision must be made for financing new construction on roads which were state highways but for which no provision had been made in the bond acts. This very apparent need was met by the 1927 Session of the State Legislature by the passage of an act providing for an additional 1 cent tax on gasoline, the proceeds to be placed in the State Highway Construction Fund and used exclusively for new construction projects. A similar bill had been defeated in 1925.

Austin B. Fletcher...Highway Builder

By C. C. CARLETON, *Chief of the Division of Contracts and Rights of Way, State Department of Public Works* *

EASTERN dispatches on March 8th announced the passing of one of the most notable highway engineers of our time—Austin Bradstreet Fletcher, first State Highway Engineer of California.

Perhaps no modern road builder has a more impressive record of achievement than he. Certainly none has more greatly influenced the thoughts and methods of his associates and contemporaries.

Mr. Fletcher was born at Cambridge, Massachusetts, 56 years ago. He was educated at Harvard University. From 1893 to 1910 he was secretary and executive officer of the Massachusetts Highway Commission which was considered a model in highway practices in the United States. In 1910 he was chosen as secretary-engineer for the San Diego County, California, Highway Commission after a careful consideration of the outstanding road engineers of America. In 1911 he was selected by Governor Hiram W. Johnson to head the first State Highway Department of the State of California, in which capacity he also served as Director of Public Works and President of the State Reclamation Board. Since 1923 he has occupied a responsible position as Consulting Engineer for the United States Bureau of Public Roads at Washington, D. C., which was his official residence at the time of his death.

Great Organizer

Mr. Fletcher was particularly recognized as a great organizer and an adept in the selection of personnel. He had extraordinary discernment in his analyses of the character, qualifications and integrity of applicants for positions at his disposal.

It became his duty to assemble the initial engineering field forces at the commencement of state highway activities in California in 1911, and from the outset he endowed it with an esprit de corps which has probably been unequaled in any similar organization.

It is a remarkable fact that today, in 1928, every district engineer and practically every department head of the California Highway Commission has been brought into the organization and trained and developed by him. A host of others in public employment everywhere have been the beneficiaries of his tutelage.

Loyal Staff

It may be safely stated that no public executive in California ever had a more loyal and devoted staff than he during his long tenure of the position of State Highway Engineer of California. His co-workers prized it as a privilege and a distinction to labor under so precise, systematic and cultured a friend and leader as Mr. Fletcher; indeed, from him they received a liberal education in the proper forms, niceties and methods of business management and engineering practice.

Mr. Fletcher was called to California because of his widespread reputation as a road builder and because he was considered big enough to establish precedents rather than to follow in the footsteps of other men. So well did he install system in California that few changes have been made or perhaps can be made in the engineering principles and standards devised by this far-seeing pioneer of highway development. His ideas and ideals will ever remain foundation stones of the organization structure of the State Highway Department of California.

Strict But Kindly

He was a strict disciplinarian but tempered his discipline with such kindness and consideration that few stings were ever left and but few subordinates took umbrage at his endeavor, as he humorously expressed it, "to keep them in their own corrals."

To many who did not truly know him Mr. Fletcher was considered somewhat austere and aristocratic. He was a man of quiet dignity, worthy ancestry and scholarly accomplishments, and by some he was misjudged and by others misrepresented.

But to those who really knew him his human and engaging qualities were predominant and they feel a profound personal grief at his taking.

The writer first met Mr. Fletcher when he arrived in San Diego to undertake the construction of the first county highway system of San Diego County nearly two-score years ago.

He was then spoken of as a "typical" New Englander personifying the manners, culture and traditions of the East.

But he was to become a pathfinder in road building in the West. Western ways were new to him at first, but in the years to follow he adjusted himself to his surroundings and the closing statement may be safely ventured that could he now express himself he would prefer to be borne in mind by his friends in the West as a gentleman and a Californian.—*From California Highways and Public Works of April, 1928.*

* Mr. Carleton retired March 1, 1949, after 37 years of state service. He wrote this tribute to Mr. Fletcher for California Highways and Public Works in April, 1928.

Roads Classified

An additional act also was passed classifying the various highways into primary and secondary roads, and grouping the counties into 13 southern and 45 northern counties. Funds were allocated 75 percent to primary roads and 25 percent to secondary roads. Funds for primary roads were further divided in accordance with the mileage of such roads in each county group, and the secondary road funds were apportioned equally to each county group. The 1 cent additional tax was the first definite fund provided for the various roads taken into the State Highway System by the several acts of the Legislature. These roads had been added at various times, in many cases without provision of funds for their construction.

In 1927 the Legislature also passed an act providing for the collection of a stage line franchise tax on motor stage lines

operating in California. The net revenue derived from this tax was apportioned one-half to the counties of California and one-half for use in construction of state highways. This act was repealed in 1933.

Engineering Departments Reorganized

In July, 1927, the Department of Public Works was recreated. A new act, passed by the 1927 Legislature and approved by Governor C. C. Young, provided for at least four divisions, consisting of the Division of Engineering and Irrigation, the Division of Water Rights, the Division of Architecture and the Division of Highways. The State Highway Engineer became Chief of the Division of Highways. To these, the Division of Contracts and Rights of Way and the Division of Motor Vehicles were subsequently added, but by the act of the 1931 Legislature the Division of Motor Vehicles was taken out of the Department of Public Works and made a separate state department. The act of 1927 also provided for a Highway Commission consisting of five members appointed by the Governor, serving without remuneration, and who were given the power to alter the routes of any state highway, abandon portions no longer required, authorize the condemnation of rights of way, and allocate money for the construction and repair of the various state roads.

Commission Duties Transferred

All other duties of the previous commission were transferred to the Director of Public Works as head of the Department of Public Works; the director and the State Highway Engineer both being appointed by, and serving at the pleasure of the Governor.

B. B. Meek of Oroville was appointed Director of Public Works, C. H. Purcell was named State Highway Engineer and Chief of the Division of Highways, and the following were made members of the California Highway Commission: Ralph W. Bull, Chairman, Eureka; J. P. Baumgartner, Santa Ana; M. B. Harris, Fresno; Joseph M. Schenck, Los Angeles; Fred S. Moody, San Francisco. E. Forrest Mitchell of Belvedere was made secretary.

Toll Bridge Authority Created

In 1881 an act of the Legislature provided for the granting of franchises by the State for constructing bridges across navigable streams, estuaries and arms of bays, requiring approval by the State Engineer of the width of draw and the length of span of such bridges. This statute was in force until its repeal in 1929 by the approval of an act regulating the construction, maintenance and operation of toll bridges and toll roads, and an act declaring the policy of the State of California relative to toll bridges, and creating the California Toll Bridge Authority.

During the Forty-seventh Session of the California State Legislature in 1927, an act was passed and approved by the Governor authorizing the California Highway Commission to investigate the operation of toll bridges within the State, and to submit a report of its findings with recommendations to the Forty-eighth Session of the Legislature in 1929.

Based upon this report and the accompanying recommendations, the act above referred to, declaring the policy of the State of California relative to toll bridges and creating the California Toll Bridge Authority, was approved.

Toll Bridge Policy

Briefly, it was declared to be the policy of the State to acquire and own all toll bridges situated along or upon any part of the highways of the State, with the end in view of ultimately eliminating all tolls thereon.

The California Toll Bridge Authority, created by the same act, is a body empowered to authorize and direct the Department of Public Works to acquire, construct and operate toll bridges across navigable or unnavigable streams, estuaries, or bays, which are either wholly or in part within the State of California.

The Toll Bridge Authority was also authorized to issue bonds for the acquisition or construction of such toll bridges secured only by the revenue derived from the tolls to be collected, the bonds to be retired and the interest to be paid upon them by the collected tolls.

Toll Bridge Jurisdiction

The act regulating the construction, operation and maintenance of toll bridges, approved at the same time as the one creating the Toll Bridge Authority, vested exclusive jurisdiction of such bridges in the Department of Public Works. It empowered the Department of Public Works with the acquisition, construction and operation of all toll bridges, as well as fixing tolls to be charged.

Also in 1929 the Hoover-Young San Francisco Bay Bridge Commission was appointed by President Hoover and Governor Young and the Division of Highways was entrusted with the preparation of a detailed report embodying plans for the great San Francisco-Oakland Bay Bridge. The report was presented in August, 1930.

San Francisco-Oakland Bay Bridge

The 8¼-mile bridge across San Francisco Bay, which connects San Francisco with Oakland, Berkeley and the East Bay area was constructed by the San Francisco-Oakland Bay Bridge Division of the Department of Public Works. Construction of the bridge was planned and supervised by the then State Highway Engineer C. H. Purcell, who was appointed Chief Engineer in charge of the project. Its cost was financed from the proceeds of revenue bonds issued under the California Toll Bridge Authority Act. The bonds were secured by anticipated tolls.

The bridge, which is one of the largest and most costly in the world, is a double-deck structure with six lanes for automobile traffic on the upper deck and three lanes for truck and bus traffic plus two interurban railroad tracks on the lower deck. The western portion of the bridge is in reality two complete suspension bridges, each with a center span length of 2,310 feet, secured to a central anchorage midway between San Francisco and Yerba Buena Island.

Towers of the suspension bridge are from 474 to 519 feet high, and the piers range from 100 to 235 feet in depth.

The two cables are 28¾ inches in diameter, each cable containing 17,464 wires, and the total length of cable wire used was 70,815 miles—nearly three times the circumference of the earth. Total length of the 2¼-inch suspender ropes is 43 miles. East of the island the bridge is composed of a steel cantilever with a main span 1,400 feet in length, two 510-foot anchor arms, and 22 steel truss spans with lengths of from 300 to 500 feet. The west and east portions connect through a double deck tunnel on Yerba Buena Island.

The bridge was constructed at a cost of approximately $70,000,000 and is maintained and operated with gas tax funds. All toll revenue is used for the reduction of bonded indebtedness which had been reduced to $19,840,000 on June 30, 1950.

The bridge was opened to vehicular traffic on November 12, 1936, and interurban trains began travel on January 14, 1939. As of June 30, 1950, approximately 263,510,174 vehicles had crossed the bay on the bridge.

Title to the Carquinez and Antioch bridges on the upper reaches of San Francisco Bay was acquired by the California Toll Bridge Authority on September 16, 1940, and these two structures were operated as toll bridges until August 1, 1945, when they became toll free. The purchase cost to the State was $5,593,000 and retirement of the indebtedness was accomplished from tolls collected over the five-year period.

This photo of San Francisco-Oakland Bay Bridge was taken day before opening of span on November 12, 1936

Rolph Appointments

James Rolph, Jr., of San Francisco, was elected Governor in 1930, and upon taking office in 1931 he appointed a new California Highway Commission, naming Earl Lee Kelly, Redding, Chairman; Harry A. Hopkins, Taft; Timothy A. Reardon, San Francisco; Philip A. Stanton, Anaheim, and Frank A. Tetley, Riverside. John W. Howe of Los Angeles became secretary. State Highway Engineer C. H. Purcell was retained by Governor Rolph.

Colonel Walter E. Garrison, Lodi, was appointed Director of Public Works and served from January, 1931, to October, 1932, at which time he resigned. For a period of four days, October 10th to October 14th, California's Department of Public Works for the first and only time in its history had a woman as its head. In recognition of 20 years of service to the State, Governor Rolph appointed Miss Myrtle V. Murray, the department's secretary, to be interim Director of Public Works. Miss Murray entered the employ of the Division of Highways in 1911, served in the offices of Governors Hiram W. Johnson and William D. Stephens and in 1921 was named Secretary of the newly created Department of Public Works.

Earl Lee Kelly succeeded Miss Murray on October 14, 1932, and Mr. Hopkins became chairman of the commission, and Dr. W. W. Barham of Yreka took Mr. Kelly's place on the commission.

City Highway Funds

In 1933 the legislation establishing the gasoline tax was amended to provide that an amount equal to one-fourth cent of the State's share of the 3-cent tax should be apportioned to incorporated cities in proportion to their population for construction and maintenance of state highway routes through the cities or on other city streets. The administration of these one-fourth cent funds was entrusted to the Department of Public Works which apportioned the amounts to the various cities and required that the local authorities submit project statements of proposed improvements for approval in accordance with the legal provisions of the Statutes as amended in 1935 requiring this one-fourth cent be used on state highway routes within cities. By this method smaller cities were given the advantage of the Division of Highways' organization and experience and in all

cases improvements were kept to uniform standards.

One Highway Fund

This 1933 amendment also lifted the restriction stipulating that the State's share of the 1923 gasoline tax could not be used for new construction and provided that all funds accruing to the State for highway purposes be placed in a single fund. Provision was made that allocations to construction, reconstruction and maintenance be left in the hands of the California Highway Commission in the adoption of biennial budgets with the restriction that an amount equal to not more than the revenue from 1-cent tax per gallon of gasoline be budgeted for maintenance and that administration charges should not exceed 2 percent of the revenue.

More Mileage Added

The 1933 Legislature likewise amended the State Highway Classification Act of 1927. By this amendment approximately 6,700 miles of county roads and city streets were added to the State Highway System, thereby more nearly equalizing the secondary mileage between the northern and southern groups of counties. Under this 1933 legislation all funds budgeted for construction and improvement were allocated equally between the primary and secondary road systems. The half apportioned to work on primary roads being divided in the ratio of the primary mileage in the 45 northern counties to the primary mileage in the 13 southern counties.

To meet the changed conditions due to rapid growth it was found advisable by the Division of Highways to make certain adjustments within the organization. The 10 districts into which the State had been divided for purposes of administration were increased to 11. Changes in some boundary lines between other districts were effected to equalize mileage and two district offices were moved to more central locations. The new District XI, comprising San Diego, Imperial and part of Riverside Counties, was established with headquarters at San Diego. The offices of District III and District X were moved from Sacramento to Marysville and Stockton, respectively.

Merriam Becomes Governor

On June 2, 1934, Governor Rolph died and Lieutenant-Governor Frank F. Merriam became Acting Governor. He was at the time a candidate for Governor in the campaign of that year and in November was elected chief executive of the State, taking office in January, 1935.

Governor Merriam retained both Mr. Kelly as Director of the Department of Public Works and C. H. Purcell as State Highway Engineer; Edward J. Neron of San Diego was named Deputy Director of Public Works in August, 1934, and in February, 1935, Julien D. Roussel, Long Beach, was chosen secretary of the Highway Commission. The following month, Justus F. Craemer, Orange County newspaper man, who had served as Governor Merriam's private secretary, was appointed Assistant Director of the Department of Public Works, with headquarters in Los Angeles.

New Commissioners Appointed

On May 21, 1935, Governor Merriam appointed Ray Ingels of Mendocino County, former Assemblyman and State Senator, a member of the Highway Commission, succeeding Dr. W. W. Barham of Yreka. Mr. Ingels became Director of the Department of Motor Vehicles in August, 1935, thereby creating a vacancy on the commission. On July 24, 1935, Charles D. Hamilton of Banning succeeded Frank A. Tetley on the commission. Mr. Hamilton died suddenly April 24, 1936. W. T. Hart of Carlsbad succeeded Mr. Hamilton.

Governor Merriam made two more appointments on May 6, 1936, naming as members of the Highway Commission H. Ray Judah, of Santa Cruz, to succeed Timothy A. Reardon, San Francisco, and Paul A. Jasper, Fortuna, to fill the vacancy caused by the resignation of Mr. Ingels.

Appointment of Justus F. Craemer to be Building and Loan Commissioner October 4, 1937, resulted in the elevation of Harry A. Hopkins, to the post vacated by Mr. Craemer and the appointment of Robert S. Redington of Los Angeles to succeed Mr. Hopkins on the Highway Commission.

In January, 1939, Culbert L. Olson became Governor and appointed Frank W. Clark Director of Public Works. In March of that year, the Governor named a new California Highway Commission with the following members: Larry Barrett, Chairman, San Francisco; Iener W. Nielsen, Fresno; Amerigo Bozzani, Los Angeles; and Bert L. Vaughn, Jacumba. Director Clark served as a member of the commission until April, 1939, when L. G. Hitchcock of Santa Rosa was appointed to make up the full membership of the commission. State Highway Engineer Purcell was retained in his position throughout the Olson regime.

Warren Assumes Office

Earl Warren assumed office as Governor in January, 1943. He immediately appointed State Highway Engineer Purcell to the post of Director of Public Works and George T. McCoy moved into Purcell's position as State Highway Engineer. For a period of several months the functions of the Highway Commission were carried on by a temporary body consisting of Gordon H. Garland, Chairman; Mrs. Dora Shaw Heffner, Miss Helen MacGregor, Verne Scoggins, and William T. Sweigert, the last three being secretaries on the staff of Governor Warren.

In September, 1943, the Governor named a permanent commission of which Director Purcell, under a new law, became chairman. The members were Harrison R. Baker, Pasadena, Homer P. Brown, Placerville, James A. Guthrie, San Bernardino, F. Walter Sandelin, Ukiah, Chester H. Warlow, Fresno, and C. Arnholt Smith of San Diego, who resigned in January, 1949. He was succeeded by Charles T. Leigh of San Diego. The original members of this commission with the exception of Smith still are serving Governor Warren, all having been reappointed when their staggered terms of office expired.

Funds Reallocated

At the 1935 Session of the Legislature an act was voted and approved providing for the allocation to cities of an additional one-fourth cent gas tax to be used for construction and maintenance of major streets other than state highway routes. For this work, submission to and approval by the Division of Highways was

required of the annual proposed budget of expenditures by each city from this additional one-fourth cent fund.

Thus, under that legislation the Division of Highways received for use on the rural state highway system one-half the net revenue of the motor vehicle registration fees and 1½ cents of the 3 cent gasoline tax. Had it not been for the increased federal appropriations for aid to states on state highway construction as a means of unemployment relief, the Division of Highways progressive construction program would have been greatly restricted.

The 1935 Legislature also provided for the collection of a state vehicle license tax on motor cars in lieu of the local personal property taxes levied by cities and counties. Net revenue from this tax was divided 25 percent to cities, 12½ percent to counties and the remainder to be used for the retirement of the three highway bond issues.

The 1937 Legislature placed a 3 cent tax on diesel oil used for highway transportation purposes, and the special legislative session of 1938 enacted that this revenue be used for reconstruction of bridges on the State Highway System which are posted for less than legal loads or speed.

The Collier-Burns Highway Act of 1947 was passed by a special session of the Legislature called by Governor Warren for the purpose of considering highway financing. The act revised the entire tax and fee structure pertaining to such financing and made substantial changes in the distribution of highway funds. *This act is fully discussed elsewhere in this issue, by Richard H. Wilson, Assistant State Highway Engineer.*

Governor Warren signs Collier-Burns Highway Act. From left to right, standing: Assemblyman Albert C. Wollenberg, Richard M. Zettel, Assemblyman Marvin Sherwin, Senator T. H. DeLap, Assemblymen Michael J. Burns, Thomas A. Maloney, Randolph Collier, Jr., Senator James J. McBride, Assemblyman M. Philip Davis, Senator Randolph Collier, Assemblymen Thomas M. Erwin, Thomas W. Caldecott, Senators Chris N. Jespersen, Oliver J. Carter, Thomas McCormack, President pro Tempore Harold J. Powers, Assemblymen George Miller, Jr., Stewart L. Hinckley, Senators Charles Brown, Arthur H. Breed, Jr., Assemblyman Robert C. Kirkwood, Senator Jesse M. Mayo, Assemblyman John L. E. Collier, Senators Ben Hulse and and George J. Hatfield. Seated—Governor Earl Warren

Chapter XIV

California Highways

By J. D. Gallagher, Assistant Office Engineer

The ink was little more than dry on Mexican documents ceding California to the Union when the news of Marshall's discovery of gold in the tail race at Coloma struck off the fevered rush for the yellow metal.

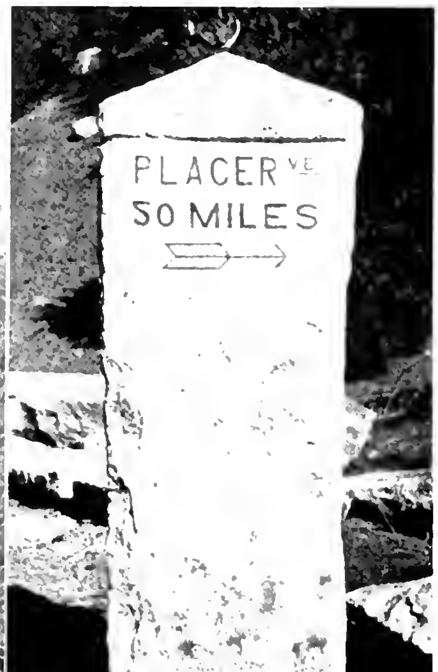
Throughout the hundred years since the news of that find spread throughout the world the trek of immigrants into California has been continuous. The incessant flow of travel, back and forth, up and down, which resulted from the ever-increasing population, has always outdistanced the development of the State's roads and highways. The need for more adequate highway development to meet the demands of traffic has been omnipresent throughout California's history.

Footpaths and Trails

As has been the case in development of all new lands, the early roads of California began with footpaths and ox-cart trails along the easiest routes between scattered settlements and villages. Here, in California, the control of topographic features and climatic conditions was such that many lines of travel were held to more or less definite routes. The Franciscan Fathers established their chain of 21 missions a day's journey apart in the protected valleys behind the rugged coast range; the crossings of the jagged backbone of the Sierra could be made only at the few natural passes provided between the towering peaks; and in the two great central valleys of Sacramento and San Joaquin the early travelers followed routes which were just high enough to miss the spreading flood waters of the two great rivers and yet avoid the rolling foothills. The vast desert wastelands of the southeastern portion of the State presented a barrier to travel which was only overcome by the relative high-speed of mechanical transportation.

From 1849 to the late sixties, all travel was over the nondescript roads which almost grew of themselves. Franchises were granted by various counties for toll roads, but few of these provided satisfactory highways and roads where more than the barest minimum of collections went into maintenance and improvement of the traveled way were exceptions. County road funds and taxes were largely exhausted in construction of bridges and

LEFT—Rubble retaining wall built by State on Lake Tahoe Wagon Road. RIGHT—Granite mile post erected by State on Lake Tahoe Wagon Road



Lake Tahoe Wagon Road showing remains of old corduroy road

primitive culverts with little left over for any development of adequate road surfaces.

Coming of Railroads

Points of the navigable Sacramento and San Joaquin Rivers became the freight terminals and trade centers. The coming of railroads in the sixties completely changed the picture and made possible a wider spread of economic development. Rail expansion likewise threw into the discard most of the established stage and freighting routes with the result that road and highway development dropped to new lows for nearly 40 years. Roads became completely local affairs and it was next to impossible to arouse sufficient interest in their improvement to raise funds for needed work.

By the nineties California, as a State, was growing up. The hectic days of the gold rush and the excitement of the Comstock boom had become history. San Francisco was one of the most cosmopolitan cities of the world. An empire based upon agriculture, mining, lumber, and export had been firmly established. Because of its great distance from ore, coal, or milled iron and steel, the basis of manufacturing, industrial development alone remained an infant.

Legislature Acts

It was then that the State Legislature became aware that a complete economic development required the tapping of all sections and the building of a system of state roads. Beginning with the problem of crossing the Sierra that body in its 1895 Session established as the first state highway the Lake Tahoe Wagon Road, from Smith's Flat near Placerville over Echo Summit to the Nevada state line at the southerly end of Lake Tahoe. The same Legislature created a State Bureau of Highways.

This first highway bureau was composed of three commissioners: R. C. Irvine, Marsden Manson and J. L. Maude. Let it be said to the lasting credit of the State's administrative officers that the commissioners appointed were selected not for their political standing but for their engineering abilities, interest and knowledge of road location and construction.

The story of their work is told elsewhere in this Centennial Issue of *California Highways and Public Works*, and it must suffice here to state that their thorough study and survey of the State, resulting in a map of a proposed state highway system and their recommendations for necessary highway legislation, were the foundations upon which was based the First State Highway Bond Act of 1909 some 12 years later.

Firm Foundations

It took this 12-year period to crystalize the recommendations of the first Bureau of Highways into action. Solid foundations are not built overnight and the foundations for California's present-day network of highways were made firm.

During this period the Legislature played around with various means of establishing an administrative set up for state roads. In 1897 the bureau was changed to a full state department with three commissioners and in 1899 the number of commissioners was reduced to one. Then in 1907 the administration of state highways was moved under the jurisdiction of the State Engineer and simultaneously with the passage of the 1909 Bond Act, the Chandler Act gave administration to a three-man Highway Commission as an advisory board to the Department of Engineering.

The personalities who guided state highway administration during the 15 years between 1895 and 1910 were, the three commissioners already mentioned, Irvine, Manson and Maude, then the successors of Irvine and Maude were W. L. Ashe and J. R. Price who, together with the ubiquitous Marsden Manson, composed the three-man commission of the Department of Highways; in 1900 J. R. Maude returned to the field as the single commissioner to direct state road activities and he was succeeded by Nat Ellery who held first the office of commissioner and then that of State Engineer. Mr. Ellery was followed as State Engineer by W. F. McClure.

UPPER—Plank culvert, typical of standards on early roads assumed as state routes between 1895-1912. LOWER—Inadequate log culvert on Lake Tahoe Wagon Road

First State Highways

During the years between the creation of the Lake Tahoe Wagon Road as the first state highway and the adoption of the integrated State Highway System under the 1909 Bond Act the Legislature designated nine other highways as state roads. In 1912, when construction began on the bond act highways these 10 state roads aggregated 550 miles in length and traversed portions of 11 counties. They were all mountain roads where development was beyond the means of the counties in which they were located. The official names and the counties traversed are as follows:

- **Alpine State Highway—El Dorado, Alpine, Mono, Calaveras, and Amador.**
- **Emigrant Gap State Road—Placer.**
- **Kings River Canyon State Road—Fresno.**
- **Lake Tahoe Wagon Road—El Dorado.**
- **Lassen State Highway—Lassen.**
- **Myers' Station-McKinney State Road — El Dorado and Placer.**
- **Mono Lake Basin State Road—Mono.**
- **Sierra State Highway—Sierra.**
- **Sonora-Mono State Road — Tuolumne, Alpine and Mono.**
- **Trinity-Humboldt State Highway — Trinity.**

State Highway System Expanded

For some years after the establishment of the State Highway System under the bond act, administration of which rested with the Highway Commission, these prior legislative state roads were administered by the State Engineer. In 1917, however, the inconsistency of two sets of state highways was eliminated by the transfer of the legislative roads into the State Highway System under the act which gave statutory recognition to the Highway Commission.

In the light of present-day highway activities the work performed on these early roads seems pitifully meager, as it was, but considering the inertia of public sentiment against expenditure of public funds in amounts sufficient for adequate development, the pioneering state highway officials of 1895 to 1911 did very well.

Most of the small sums appropriated by each Legislature were consumed in clearing up each spring the debris left by winter storms and in constructing culverts, rubble retaining walls and bridges, so that little money was left for the building of adequate road bases and satisfactory surfacing.

Early Methods Improved

These highway engineers learned early that surface preservation required a binder to prevent the fine rock dust from being whipped away by traffic. Considerable sums were spent for sprinkling, but at the same time investigations were instigated for more permanent binders. In his report to the Governor in 1902, Nat Ellery noted the satisfactory results from the use of oil in Southern California and by the time of his 1906 report he had come to the following conclusion:

"No material is quite so important to our road improvement as crude asphaltic oil. It may be used as a dust preventive, a roof to shed the rain water from the foundation, and as a lubricant to reduce the rate of wear to the road surface. While these improvements are of vast importance when properly handled, it must be borne in mind that only partial results, and in many cases no results, are obtained with improper application, selection and treatment of oil."

Mr. Ellery was on the right track of an important phase to highway development and undoubtedly he would have marveled at a section of present-day plant-mixed surfacing, but it is wondered if had he seen such a highway he could have realized that still, after 45 years of experience, highway engineers continue the search in perfecting new techniques for asphalt application as the binder in road surfaces.

Early Road Expenditures

In the year 1895-96 the 57 counties (there was no Imperial County then) of the State expended a total of $1,877,000 for road construction and maintenance and in 1896-97 the total was $1,789,000.

In 1899 when work on the Lake Tahoe Wagon Road began, the Legislature provided $5,000 for surveys and the salary of the commissioner and $20,000 for construction on that road. The Legislature also appropriated $25,000 for survey and construction of the Mono Lake Basin or Tioga Road.

Each year saw appropriation and expenditure of small amounts, the work performed being limited by the available funds even as it is today. As the number of state roads increased the total appropriations increased but not sufficiently to even keep up the pace which had been started on the two originals—the Lake Tahoe Wagon Road and the Mono Lake Basin Road.

Expenditures in 1907 and 1908 were typical and these, together with the balances at the end of the fiscal year on June 30, 1908, present a neat idea of just what the boys had to work with:

State Road, 1907-1908	Expenditures	Balance
Sonora-Mono Road		
Maintenance	$12,042.02	$644.41
Bridges	11,200.43	2,139.02
Mono Lake Basin Road		
Maintenance	2,278.05	262.69
Bridges		
Lake Tahoe Wagon Road		
Maintenance	9,227.63	772.37
Surveys	3,593.92	1,001.43
Bridges	850.26	0.09
Alturas-Cedarville Road		
Surveys only	2,199.65	4,872.68
Trinity-Tehama-Shasta Road		
Surveys only	9,299.35	40,700.65
Downieville-Sierra Road		
All expenses	11,123.33	876.67
Kings River Canyon Road		
All expenses	28,301.66*	4,825.13*

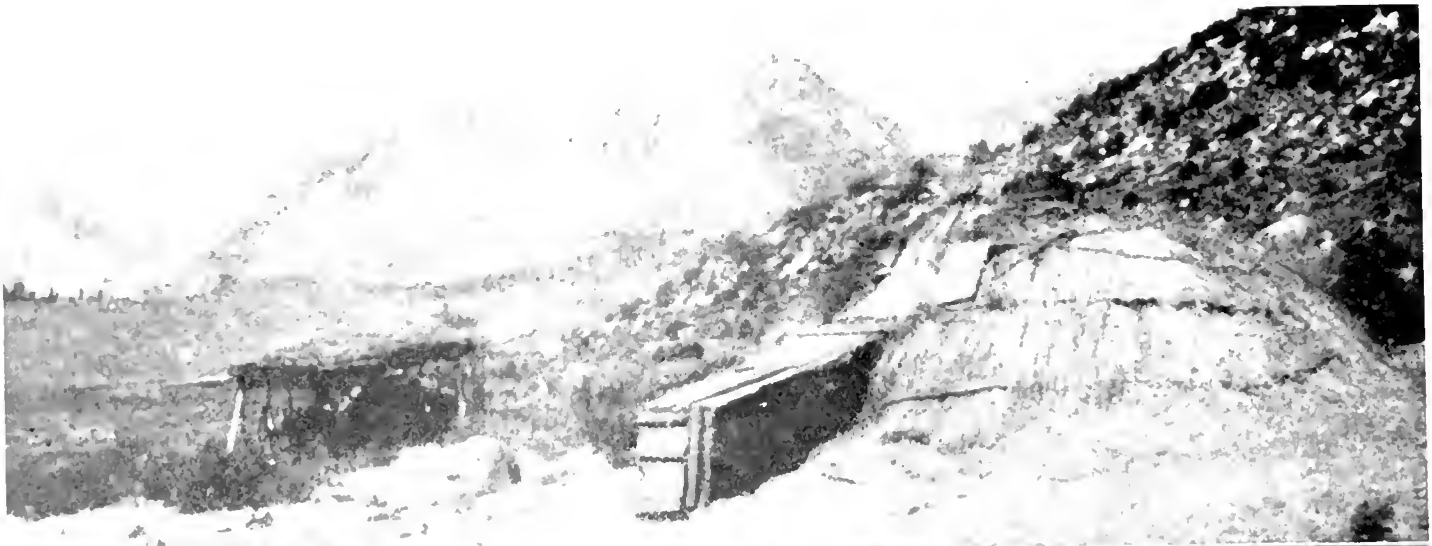
* Two-thirds by State, one-third by Fresno County.

Careful Planning

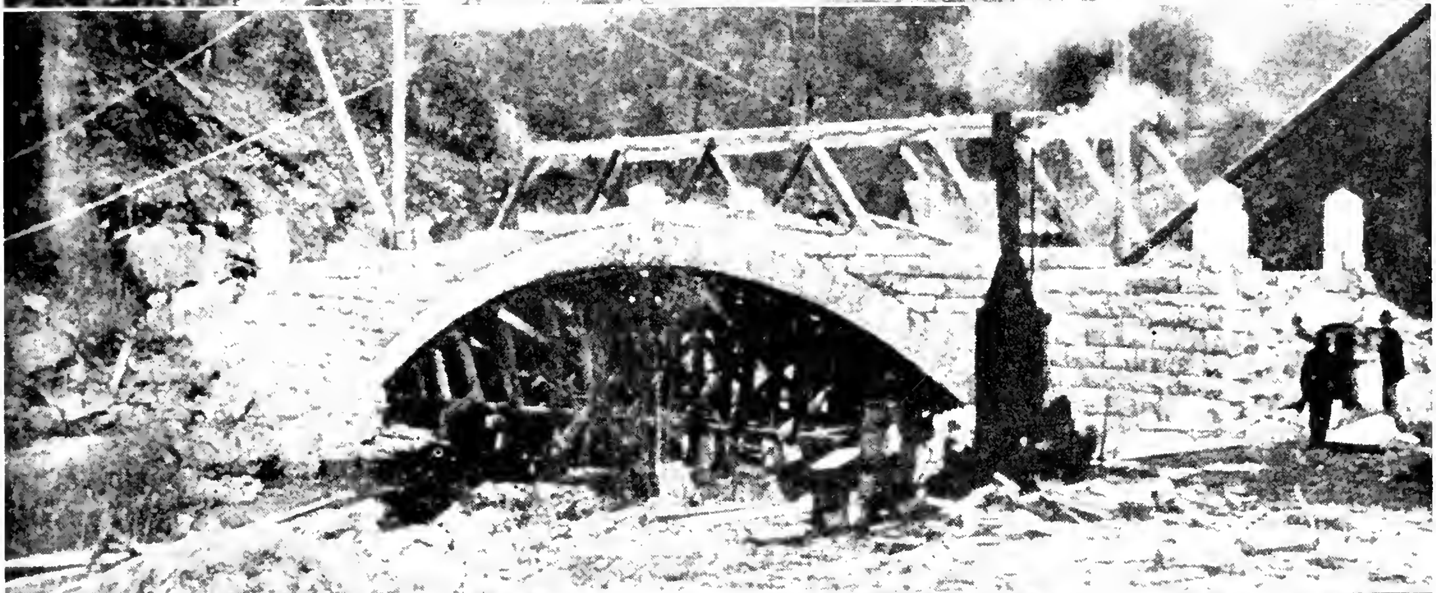
In the light of present-day financing the figures appear ridiculously small, but they represent most careful planning to secure the greatest possible return. The 9-cent balance on the bridge allotment for the Lake Tahoe Wagon Road is certainly the height of careful engineering budgetary control.

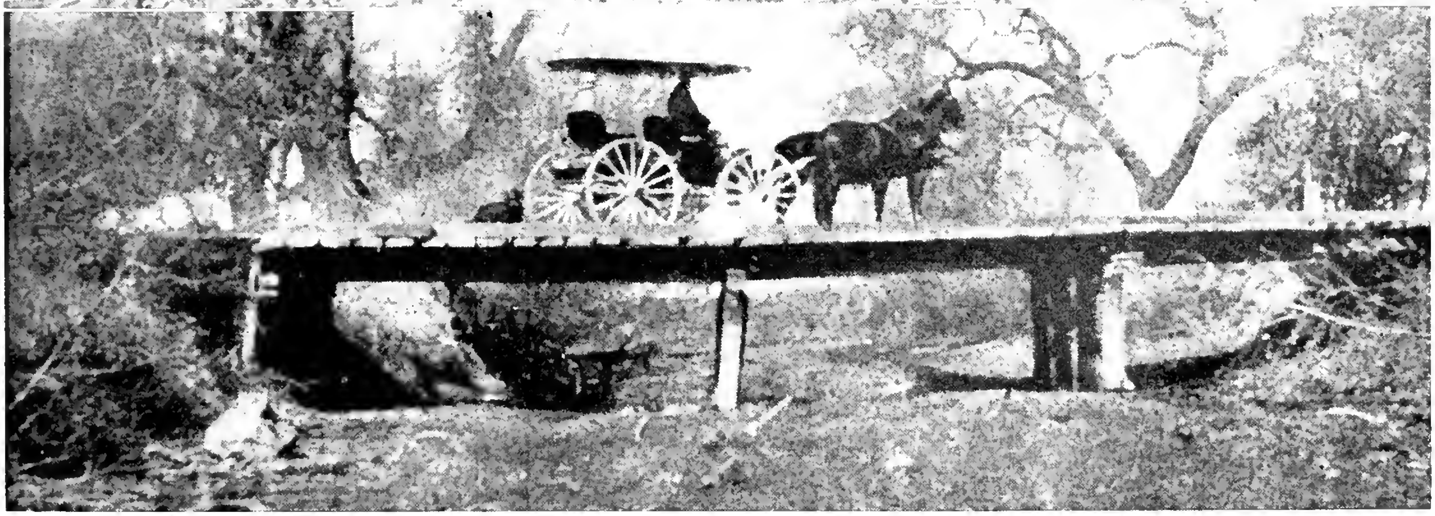
With legislative appropriations for state road development on the limited scale indicated by the figures given above for 1908 it seems quite incredible that at the 1909 session of California's legislative body a bond issue for $18,000,000 would be voted and approved and then ratified by the electorate at the 1910 general election. The reason, of course, was the rapid development of the automobile in the first decade of the century and the impetus which that gave to "good roads" movements all over the Nation.

In the nineties and first years of the new century the "Wheelmen's Associa-



UPPER—Early Indian "Wickiup" at Mono Pass. Mt. Gibbs in background. CENTER—Sonora-Mono Road on Grade to Summit, about 1904. BOTTOM—Patterson Grade, Sonora-Mono Toll Road—1897





UPPER—High type of cut-stone arch bridge built by Yolo County for crossing of Putah Creek near Monticello. CENTER—Construction of Stone Arch Bridge on Lake Tahoe Wagon Road crossing of South Fork of American River at Riverton. First major state contract on the first state highway. BOTTOM—Inadequate bridge of type built in eighties and nineties

tions" had attempted, and with some success, to stir up sentiment in favor of road and highway development, but their campaigns had been "a voice crying in the wilderness" as compared to the pressure exerted by the production of what seemed mechanically perfect motor cars. Practically every male under 50 years of age became suddenly aware that here was something he wanted, in fact it took a minimum of rationalization to convince him he needed a car, and he set his eyes on the day when that goal would be attained. If he was going to have a car, and he certainly was ("look at Joe Doakes, if he can afford to drive an automobile certainly I can"), he wanted good all-weather roads to travel on. As the story of automotive production in the United States reveals the greatest and most rapid change in the history of industrial progress, so the expansion of the "Good roads movement" from a slogan yesterday to a network of expressways and freeways today reveals the propensity of the American public to get something if they really want it and to provide the money necessary to purchase it.

Stories of Highways

The development of state highway administration after the First Highway Bond Act of 1909 is covered in another article and the fascinating stories of bridges and the development of road design and construction are given on other pages, leaving the questions "What is the net result today of the efforts of those early road builders and planners?", "What is the net result of the engineering, research, study and their trials and errors?". The answer is "The California State Highway System, 1950," or more concisely: "California Highways."

And what are some of the stories behind the individual highways which comprise the State Highway System? and what is the status of the routes included in the system? We cannot review them all but a few may be of interest.

At the risk of being slightly repetitious may we take another look at California.

Varied Terrain

Of the 48 states none holds greater variety in terrain and climate than may be found in the 159,000 square miles of California. Extending about 200 miles inland from the Pacific along some 800 miles from Mexico to Oregon, the State encompasses almost all that there is in the way of temperate climate and geologic formation.

The coast line varies from wide beaches to rocky bluffs and headlands. The broad valleys of the Sacramento and San Joaquin present typical midwestern agricultural land, hemmed in by the semibarren Coast Range on the west and the towering snow-capped Sierra on the east. The drifting sand dunes of the great Mojave Desert are arid in the extreme, while in the redwood country adjacent to the north coast the annual rainfall is 70 inches and more. The rugged terrain of southern portions of the State is broken with fertile valleys, green with citrus groves. The Imperial Valley, in the extreme southern portion of the State, consists of a millenium of silt deposits upon an ancient ocean floor made productive by water from the Rockies 1,000 miles away.

Joining these diverse sections into a unit are the 14,000 miles of road in the California State Highway System. Spreading over the State, this network of highways is composed of main arteries running north and south with major laterals to the east and west. Stemming from these principal routes are the secondary roads acting as traffic feeders.

Engineers Challenged

Development and maintenance of these state highways, traversing desert, mountains, valleys and coast of California, present problems of such variety as to challenge engineering ability and practice.

By the average motorist, modern highways are taken for granted. Travel over bridges and mountains, through tunnels and passes is accomplished with little or no thought of obstacles overcome in their construction and maintenance. A few moments over a bridge that was many months in erection; a few seconds through a tunnel which took a year or more to bore; a few hours, and an entire mountain range is crossed, the same range which took "49'ers" weeks to overcome—all are traveled with such speed and comfort that it would seem their construction must have been simple.

The factual data behind the stories of the development of the various routes in the California State Highway System are many and varied. Some reveal victory over seemingly insurmountable obstacles of nature; others are interwoven with the romance which was early California, and still others are the prosaic story of just keeping everlastingly at it. It might be that motorists could more appreciate their travels along California's highways if they were familiar with the stories behind them.

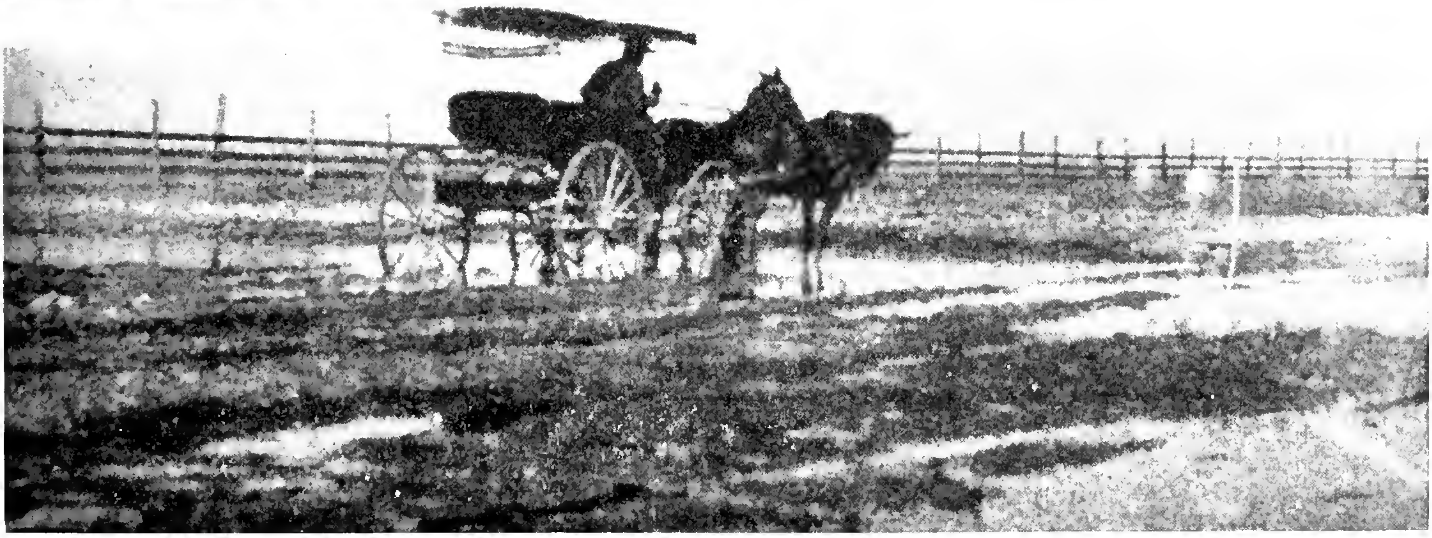
Redwood Highway

Between the Oregon boundary and San Francisco, highway U. S. 101 on its way through the wet and mountainous north coast counties passes through heavy stands of California's coastal redwoods. These trees, many of which are two to three thousand years old, rise to heights well over 300 feet and stand in dense, dank groves, with heavy undergrowth of ferns, rhododendrons and azaleas. The route is a well-paved two-lane highway with the more heavily traveled southerly portions constructed to multiple-lane standards.

For many years construction and maintenance operations on the Redwood Highway have been complicated by numerous frequent slides and slipouts through the mountainous areas of heavy rainfall along the northern coast country. The same extreme in moisture, which during the past 2,000 years has produced the famous groves of towering redwoods, has made provision of stable foundations most difficult and unique methods of engineering practice are frequently necessary to meet the problems of saturated subsoils.

Unusual Practice

An example of unusual construction practice on this route occurred in 1934 on the relocation of nine miles between Last Chance Slide and Flannigan's just south of Crescent City in Del Norte County. This revised alignment followed a line back from the ocean shore and through relatively dense redwood growth. While every effort was made to preserve the groves it was necessary to fell a few large trees ranging to 17 feet in diameter and rising to from 250 to 300 feet into the sky. At that time, commercial disposition of the trees in the vicinity was impractical, so with the knowledge that redwoods, even though buried, will remain for decades in a remarkable state



UPPER—Excavation through lava rock formation on Alturas-Cedarville State Road. CENTER—Beginnings of hauling damage before track-laying tractors were ruled off the highways. BOTTOM—Poorly drained highway in Kern County

UPPER—Main Street in the then village of Vacaville in the nineties. LOWER—Winters-Davisville Road in early 1900's. A high type of county road surfacing. Davisville, Yolo County, is now Davis

Wilshire Boulevard in Los Angeles, now world-famous, as it looked in 1910

of preservation, decision was made to use the timber in construction of roadway fills.

The felled trees were cut into convenient sizes and nearly 10,000,000 board feet of timber were used in fill construction providing the equivalent of more than 30,000 cubic yards of earth embankment. By elimination of long shallow fills adjacent to the redwood embankments the area occupied by them was much less in extent than would have been required by a conventional earth fill.

The appellation of "Redwood High-

This photo shows start of early construction on Ridge Route, U. S. 99, now modernized

The two upper photos show the old Newhall Tunnel on U. S. 6, which was eliminated by excavating deep cut for present highway shown below

way to this route is doubly applicable to this section in Del Norte County.

Flood Damage

Back in 1922, the State was constructing a triple reinforced concrete arch bridge on the Redwood Highway across the Van Duzen River in Humboldt County, paralleling a bridge of the Northwestern Pacific Railroad. The river was practically dry and traffic was being routed over a small temporary timber structure. On October 25th it started to rain and in a few days Humboldt County experienced the heaviest storm of 76 years. On the morning of October 28th the flooded river carried out the temporary detour bridge. Traffic was then routed over an old county bridge, but it was washed away that afternoon.

Permission was immediately secured from railroad officials to lay a temporary floor on the railroad bridge and use it for a detour crossing. By 1 o'clock on the afternoon of October 29th the first truckload of lumber was delivered to the bridge and at 8 a.m. on November 1st the first automobile crossed the railroad bridge. Gates were built on the approaches, temporary semaphores were erected and deputy sheriffs and railroad flagmen placed to control traffic. Members of the Highway Commission signed waivers releasing the railroad from all liability and in turn those using the bridge were required to sign waivers in favor of the commission. As soon as the flood subsided a single-lane pile bridge was built across the river for the detour traffic and the use of the railroad bridge discontinued. Approximately 1,000 feet of the bridge was floored, using some 53,000 feet of lumber, with another 10,000 feet used in the approaches.

Golden Gate Bridge

The Redwood Highway has its southerly terminus at San Francisco, crossing the historical Golden Gate on the longest single suspension span bridge in the world. This monumental structure across the entrance to San Francisco Bay was constructed by the Golden Gate Bridge and Highway District between 1932 and 1937. The total length of the bridge and

This photo of the California Highway Commission, 1923-1927, and engineers of the Division of Highways was taken on top of the Forum Building in Sacramento in 1924, which then housed the commission

FRONT ROW, LEFT TO RIGHT—John H. Skeggs, Division Engineer, Division IV, San Francisco (now Assistant State Highway Engineer); Fred J. Grumm, Engineer of Surveys and Plans, Headquarters, Sacramento (now Deputy State Highway Engineer); R. M. Morton, former State Highway Engineer, Sacramento; Louis Everding (deceased), Arcata, Member of California Highway Commission; Harvey M. Toy (deceased), Sacramento, Chairman, California Highway Commission; Nelson T. Edwards, Orange, Member, California Highway Commission; J. B. Woodson, Division Engineer, Division VI, Fresno; Frank G. Sumner (deceased), Division Engineer, Division IX, Bishop; C. S. Pope (deceased), Headquarters Construction Engineer, Sacramento; W. S. Crauthers (deceased), Assistant Engineer, Headquarters, Sacramento. BACK ROW, LEFT TO RIGHT—Frank B. Durkee, Editor, California Highway Bulletin (now Deputy Director of Public Works), Sacramento; W. F. Mixon (deceased), Woodland, Secretary, California Highway Commission; A. J. Wagner, Headquarters Maintenance Engineer, Sacramento; George R. Winslow, Division Engineer, Division III, Sacramento; Lester Gibson, Division Engineer, Division V, San Luis Obispo; J. C. McCloud, Division Engineer, Division X, Sacramento; H. S. Comly (deceased), Division Engineer, Division II, Dunsmuir; E. Q. Sullivan, Division Engineer, Division VIII, San Bernardino; T. E. Stanton, Assistant State Highway Engineer, Sacramento; S. V. Cortelyou, Division Engineer, Division VII, Los Angeles; T. A. Bedford, Division Engineer, Division I, Willits.

approach structure is 8,981 feet, the length of the suspended structure is 6,450 feet, and the length of the main span is 4,200 feet. The towers which support the two 36-inch cables rise 746 feet above the water.

Building the Marin County approach to the Golden Gate Bridge presented some unusual construction problems. This section of the Redwood Highway traverses coastal mountain slopes for the greater portion of the 3.6 miles from Waldo to the bridge. While the terrain is rough and construction involved cuts and fills up to 200 feet in vertical depths, the usual attendant difficulties of such work were increased by the lack of even average mountain stability. The excavation and slides which developed required the moving of more than 2½ million cubic yards of material. The project required a tunnel near the crest with a length of 1,000 feet and a bore 29 feet in height and 46 feet in width. Construction of this four-lane approach to the Golden Gate Bridge cost approximately $2,000,000.

Shasta Dam Relocation

U. S. 99 is the central arterial of the California State Highway System, from the Oregon line to the Tehachapi it practically bisects the State. Its development to standards adequate for the large volume of traffic using the route has been a continuing process in the State's highway program since 1912. The portion of the route through the Siskiyous and Sacramento Canyon is built to good two-lane standards.

The construction of Shasta Dam, the largest unit of the great Central Valley water and power project, required relocation of 19.5 miles as well as many miles of railroad, through rough, forbidding mountainous terrain over which earlier locators did not have the temerity, nor the need, to build.

Here was a situation of concurrent construction almost unique in highway-railroad relations. The more lenient and elastic limitations permitted by the motor vehicle required that the highway bow to the more stringent railroad standards, wherever the two conflicted. In relocation of the two transportation facilities

highway and railroad cross and recross five times, with only one a conventional grade separation structure. Three occur over tunnels deep in the mountain side, and the fifth takes place at the common crossing of the Pit River, where the highway uses the upper deck and the railroad the lower of a $5,000,000 steel bridge.

Heavy Grading

The highway portion of this project contains some of the heaviest grading ever undertaken on two-lane construction in Northern California: With a total of 2,850,000 cubic yards of excavation; 726,000 cubic yards in one mile, with cuts up to 275 feet and fills as high as 289 feet.

Notwithstanding more difficult topography, the new route, opened to traffic in 1943, is safer, faster, and almost four miles shorter than the old road. Its most outstanding unit is the massive Pit River Bridge, a 3,588-foot, eight-span, double-deck steel structure. This bridge, built by the Bureau of Reclamation which supervised construction of the dam, provides a four-lane crossing for the highway on its upper deck 530 feet above the river bed; and on the lower deck, a double track for the railroad. While two of its massive concrete piers are among the highest in the world, more than 350 feet, they barely emerge from the high level of the lake formed by the dam.

Dwarfed only by comparison with its bigger sister is the 1,330-foot, seven-span bridge across the Sacramento River at Antler, near the northern end of the new location. This structure, designed and built by the Division of Highways, is interesting because of its complicated design on both vertical and horizontal curves.

In the Sacramento Valley U. S. 99 divides at Red Bluff to reach Sacramento on routes both easterly and westerly of the Sacramento River. On the east side one of the most prominent features is the 2,700-foot steel girder bridge across the Feather River bridge between Marysville and Yuba City.

North of Sacramento this interstate route is built to two-lane standards over most of its length, with short sections of four-lane divided highway at a few locations of traffic congestion. Construction under way at this time will complete a four-lane divided highway between Anderson and Redding.

State highway in San Benito County. Typical of highways made possible by first bond issue

Feather River Highway

Carved out of solid rock, hewn through granite cliffs, criss-crossing mountain streams, the Feather River Highway is another thrill for the sightseeing motorist, as well as a joy and comfort to the Plumas County highlanders. But more than this, the road stands as a monument to the intrepidity of the locating engineer, the skill of contractors and the dogged effort of labor.

The Feather River Highway is the only road over the Sierra that avoids the heavy snow area of the higher altitudes. Throughout most of its length it follows easy river gradients. Such a road has many advantages, but easy construction and low initial cost are not among them. It took more than nine years to build and cost well over $7,000,000, almost $100,000 per mile, and nearly 8,000,000 cubic yards of material, 85 percent of which was solid rock, were moved in its making.

Natural Obstacles

Natural obstacles to the location of a highway through this rugged country of steep canyon walls and glacier-polished precipices were as formidable as ever confronted the locating engineer. These were complicated by man-made barriers; a transcontinental railroad, powerhouses, transmission lines, and future power reserves. The railroad, built over 40 years ago, naturally had taken the easiest route, and the highway had to make the best of what was left, leaping across the canyon as the railroad crossed oppositely below or playing hide-and-seek around and over tunnels.

For 10 of the most difficult miles, the road follows a niche cut in the solid wall of the canyon. Three tunnels pierce the

Modern log-stringer spans over Trinity River on private road near Douglas City; built in 1945

most precipitous projections under Arch Rock and through Grizzly Dome, a huge, bowl-shaped mass of bare granite which rises starkly for 1,000 feet above the river.

At Pulga, a 350 foot steel arch joins rocky cliffs of the canyon 200 feet above the river straddling and dwarfing the railroad bridge that crosses at right angles 170 feet below.

The entire route along the Feather River between Oroville and Quincy is one of natural beauty—pine-covered mountain sides punctuated with masses of granite—a section in the California State Highway System which creates an everlasting impression.

U. S. 40

Probably the most important interstate highway in California is U. S. 40. This heavily traveled route enters California a few miles west of Reno, crosses the high Sierra over Donner Summit at an elevation of 7,000 feet, passes through Sacramento on its way across the valley, reaches the Bay area over the Carquinez Straits Bridge near Vallejo, and ends in San Francisco via the San Francisco-Oakland Bay Bridge.

While the El Camino Real along the coastal sections of the State is much older, the U. S. 40 route is of considerable historical importance in that it crosses the Sierra over the trace traveled by the ill-fated Donner Party and followed by thousands of forty-niners in their cross-country journey to California. Since that time, development of portions of the route has been relatively continuous. Since establishment of the State Highway System in 1912, work on this development has been carried on with no appreciable interruption.

Donner Summit

In the period during which California was first experimenting with road construction on the state level, that is between 1895 and 1912, the Donner Summit crossing of the Sierra was made a state highway. While it had been built originally as a freight route in the sixties, when taken over by the State this highway, known as the "Emigrant Gap Road," consisted of a rocky wagon track with only those boulders removed which were too large to permit passage of high-wheeled wagons. By dint of continual labor it was gradually improved with state highway funds but it was not until the twenties that it could be really classed as a highway.

This is realigned U. S. 40 on freeway design through Auburn, Placer County, to a connection with the existing route east of Auburn

Today, the road is considered one of the best mountain highways in the Nation, with a section of typical metropolitan freeway development through Auburn and its extension underway between Auburn and Applegate.

U. S. 40 enters Sacramento from the east over the full freeway through North Sacramento and funds are budgeted and earmarked for continuation of this freeway to Roseville.

Between Sacramento and San Francisco all but 10 miles of the 90-mile total is now four-lane highway and contracts now in progress will bring nearly seven of the 10 miles to four-lane divided standards. Structure projects are also under contract as the first units in development of the remaining mileage to freeway standards. Thus with completion of projects now started the entire 90-mile portion will be four-lane highway, all divided but the section between Richmond and the Carquinez Bridge.

Since the end of World War II, the Division of Highways has expended $16,120,000 on improvement to U. S. 40 which has involved 111 miles of construction.

San Francisco-Oakland Bay Bridge

The $70,000,000 San Francisco-Oakland Bay Bridge is by far the biggest single project ever undertaken by the Department of Public Works, and rightfully is the most renowned. Spanning 4½ miles of navigable water between the two metropolitan areas, its spectacular construction progressed in full view of thousands of city dwellers and com-

Freeway on coastal road between Rob Roy Junction and Santa Cruz

muters who gained thereby an appreciation of the immensity of the task. But after twelve years even the former "ferry rail superintendents" who now travel the bridge, secure in fog and storm, seldom recollect that this mighty structure took six years to complete or that it holds many world-wide records, foremost among them, the greatest length, the deepest piers, and the largest vehicular tunnel bore.

The west crossing between San Francisco and Yerba Buena Island, is unique for its twin suspension spans, held by a common anchorage in midchannel. The wire in the 28¾-inch suspension cables would encircle the earth nearly three times. Its towers reaching as high as 519 feet above water and its piers as much as 242 feet below the surface would overtop a 60-story skyscraper. The 540-foot tunnel through Yerba Buena Island was bored 76 feet wide and 58 feet high to provide for the double deck construction. The east crossing, between Yerba Buena Island and Oakland, is a steel bridge, the main cantilever span 1,400 feet long. The total length of the bridge from the San Francisco terminal, to the toll plaza at the Oakland end is 8¼ miles.

Huge Quantities of Materials

Building the bridge required materials in quantities rarely encountered in a single structure. Over 152,000 tons of structural steel were erected, 30,000 tons of reinforcing steel were placed and the suspension cables required 18,500 tons of wire; the concrete amounted to 1,000,000 cubic yards which required 1,300,000 barrels of cement; 30,000,000 board feet of timber and lumber were used and it took 200,000 gallons of paint to cover the bridge.

To the construction of the bridge even prehistoric animals contributed their bit—or rather their all—yielding their final resting place to make room for the piers; dredges reached into prehistoric time in excavating for their foundations, pulling a mastodon's tooth and an ancient bison's bones from the ooze 180 feet below the bottom of the bay.

Along with the Golden Gate Bridge, Hoover, Shasta, and Grand Coulee dams, the San Francisco-Oakland Bay Bridge stands out as one of the foremost structures in the West.

Santa Cruz Lateral

Modernization of the scenic route across the redwood-covered Santa Cruz Mountains between Los Gatos and the shore line at Santa Cruz has been another undertaking of the first magnitude. The original highway, one of the old "county seat laterals" provided in the State bond issue of 1909, was considered a bold location for its time but, typical of mountain roads of the early days, its tortuous alignment and narrow width became more and more obsolete with the years as traffic speed and volume increased.

Connecting the densely populated San Francisco Bay area with attractions of the Santa Cruz and Monterey coast lines, this is one of the most heavily traveled recreational highways in the State. Those who remember the congestion and dangers on the old two-lane route, when holiday motorists crawled at a snail's pace or risked their lives in passing other cars, can best appreciate the modern four-lane highway through the heavy mountain sections and three lanes through the valleys and flats. Through the heart of the mountains traffic now travels 13 miles of modern alignment with but 42 easy curves instead of 16½ miles of dizzy serpentine of 284 sharp curves, a difference in total curvature equivalent to 36 full circles.

The 20.6 miles of new construction five miles shorter than the old road)

progressed by stage construction over a period of 9½ years from 1931 to 1940. It involved 11 road and bridge contracts totaling approximately $3,000,000, one of them the largest grading contract ever undertaken by the Division of Highways —more than 2,500,000 cubic yards in 6½ miles.

Unusual construction problems in this development and their solution commanded the interest of highway circles throughout the Nation. Treacherous ground conditions and proximity to the San Andreas fault, which the highway crosses, required rigorous foundation treatment in construction of heavy fills. This work involved such practices as stripping the earth blanket to bedrock and replacing with imported rock base; constructing heavy rock tow-walls for fills; and most extensive trenching and sub-drains. At one section, through narrow Los Gatos Creek Canyon, the highway was squeezed between the steep slope of the mountain and a railroad at the bottom. In this location, two of the four lanes are carried on a reinforced concrete and steel pile sidehill viaduct for a distance of about 1,000 feet.

To thousands of motorists this route provides easy access from the Santa Clara Valley at the southerly end of San Francisco Bay to mountain resorts among the redwoods or on to the beaches at Santa Cruz and its neighboring Capitola, as well as a pleasant way of reaching Carmel and the Monterey Bay area, by way of the recently constructed Santa Cruz-Rob Roy freeway along the coast.

Carmel-San Simeon Highway

Along the California Coast, the Shoreline Highway offers 450 miles of most beautiful scenery. However, the very topographic features which make the charm of this rugged coast line presented survey parties and construction crews with some of the most dangerous and difficult work ever experienced by Division of Highway forces. From the redwood country of Mendocino County, this route follows the ocean shore, past settlements founded by the Russians early in the Nineteenth Century, to San Francisco, and on to the south through historic Monterey to one of the Franciscan Fathers' earliest missions in San Luis Obispo.

Much of the present state highway is a relocation of earlier routes which have led a precarious existence, literally "between the devil and deep, blue sea"—the devil of slides and erosion on one side, and the menace of the ocean's fury on the other. A short portion in San Mateo County, was built upon the bed of the abandoned Ocean Shore Railroad; but 68 miles of the southerly portion, from beautiful Carmel to sinister Morro Rock, represent pioneer construction through one of the wildest and most precipitous sections of the entire coast.

Sixteen Years to Build

This latter portion was 16 years in building (1921-1937) and cost $9,000,000. It required the removal of 13,000,000 cubic yards of material; one massive promontory alone, Limekiln Bluff, yielded 163,000 yards —97,000 in a single blast. The lack of stability of the rock formations of these coastal ridges was a source of much difficulty in the highway's construction. Severe and sudden slides threw tons of material into the ocean at the foot of the bluffs. One such slide carried a contractor's large power shovel with it into the pounding surf.

Thirty-two bridges were required to span the numerous gorges which empty into the ocean along this coastal country, five of them being graceful arches. Bixby Creek Bridge, 18 miles south of Carmel, is the west's longest reinforced concrete arch—342 feet. In stately grandeur, it crosses one of the most precipitous gorges, a breath-taking 270 feet above the tide. Big Creek Arch is another unusual structure. It consists of two 177-foot 6-inch arches and two hinged half-arches, all of reinforced concrete. This bridge is unique for two floating end-spans which allow for settlement of unstable ground at the abutments.

Despite the hazards and difficulties of construction, the Division of Highways has provided an interesting and scenic road benched into the bluffs of the Monterey Coast with the blue Pacific breaking in white-foamed surf below and stretching off to the western horizon.

Mother Lode Highway

From an historical point of view, one of the most interesting state routes is the Mother Lode Highway which traverses the heart of California's early gold mining country. The northerly terminus of this route is the City of Auburn, in Placer County; from this point the highway extends southerly through the Sierra foothills to Mariposa, a distance of 169 miles. The route is well surfaced throughout its entire length. The country touched by this route was the setting for much of California's gold rush, when many an early day miner searched these hills for the fabulous Mother Lode, mythical source of the yellow wealth. A list of towns and place-names in the region through which this highway passes would furnish a good index for Bret Harte stories or the early writings of Mark Twain.

Between Auburn and Placerville the route passes through the old settlement of Coloma on the South Fork of the American River, where in 1848 the millwright, James W. Marshall, touched off the California gold rush by discovery of gold in the tailrace of a sawmill he was operating for Captain John Sutter. From here the highway then moves down into old Placerville, referred to by forty-niners as "Hangtown," because of its speedy and final system of frontier justice to malefactors against the pioneer code.

Picturesque Towns

From Placerville, the Mother Lode Highway traverses oak-covered rolling foothills dotted with towns bearing those picturesque names so reminiscent of the free and easy days of the gold rush: El Dorado, Fiddletown, Fair Play, Grizzly Flat, and Dry Town. From Dry Town, the oldest community in Amador County, the name of which was a misnomer in the early days as far as liquid refreshment was concerned, the highway, crossing through a saddle in the ridge south of Rancheria Creek, follows up Amador Creek to the sleepy village of Amador City where crumbing buildings are the chief evidence of the one-time activity around the old Keystone mine. The road crosses the next ridge at the same point as the old "Amador Trail" of the fifties, evidence of which may be seen in the old stone walls and grass-covered roadway. In the valley below this summit lies the attractive town of Sutter Creek, with neat lawns and houses settled beneath large shade trees. While many of the buildings here date back to the roaring gold days, most have had facial treatments, concealing their age

behind modern fronts which to some degree detract from the old time atmosphere of the vicinity.

Hetty Green Mine

Leaving Plymouth, the motorist may see the old so-called Hetty Green mine, formerly the Eureka, which is now owned by the Central Eureka Company. In 1859, Alving A. Hayward bought this property and between 1852 and 1881 it had produced $13,000,000. Hetty Green, who amassed a fabulous fortune, owned the mine for a period and it still is popularly referred to as the Hetty Green mine.

Out of this valley the highway continues southerly to a junction at Martel with the Jackson lateral and continues on down to Jackson, the county seat of Amador County. Adjacent to the highway on the outskirts of Jackson are the properties and workings of the famous Argonaut and Kennedy mines, two of the largest in California. Because of these two mines, there is a large population of hard-rock miners in Jackson and the town retains a typical mining atmosphere in spite of the modernization of many of the buildings. The old courthouse is a point of considerable historic interest, where even as late as 20 years ago, the old town well with its bucket and rope was in general use by the neighborhood. The National Hotel in Jackson witnessed much excitement during the fifties, including the hanging from a tree (which formerly stood in front) of an entire gang of Mexican desperadoes who had murdered all of the adult residents in a rooming house on Rancheria Creek. The only survivor of this tragedy was a small baby who was thrown out a second-story window with her throat cut. She recovered, however, and lived to raise a family.

Carson Pass Lateral

In the center of Jackson, the Carson Pass lateral takes off from the Mother Lode Highway to wind its way up to the top of the Sierra, crossing the summit at elevation 8,650 beyond beautiful Silver Lake and the Carson Spur. This route is along the trail followed by the intrepid Kit Carson, who guided many caravans to California.

South from Jackson, the Mother Lode Highway crosses into Calaveras County and up through the famous old mining town of Mokelumne Hill and down again to historic San Andreas and further on to Angels Camp. Through the writings of Mark Twain and Bret Harte the history of this section of the Mother Lode country is more familiar to the average citizen than that of other locations. San Andreas was the site of the famous old Metropolitan Hotel, featured in some of the writings of these two chroniclers of California's golden days. The hotel, however, was destroyed by fire 25 years ago. It was from San Andreas that the gentlemanly, but much feared, lone bandit Black Bart was sent to the penitentiary after a meteoric career as a stage robber.

Angels Camp

Angels Camp was another center of turbulent activity during the early decades of the State's existence, from which Messrs. Harte and Clemens derived the material for many of their fascinating tales. It was here that the famous "jumping frog" episode, made immortal by Mark Twain, took place. At Carson Hill, a little farther to the south, is located the celebrated Morgan mine, where a $43,000 fortune was found in a single gold nugget.

Beyond Melones and into Tuolumne County the highway moves on to Sonora, surrounded by such historical mining communities as Columbia, Rawhide, Jamestown and Chinese Camp. Between the Calaveras County line and Sonora lies the quaint little village of Tuttletown; here, a short distance off the Mother Lode on Jackass Hill is Mark Twain's cabin. Mark Twain was known as "The Sage of Jackass Hill" and the old store where he made his daily purchases is still in use.

At Sonora the Mother Lode Highway makes a junction with the Sonora Pass highway which crosses the high Sierra at an elevation of 9,624 feet to the east to connect with U. S. 395 between Bridgeport and Coleville in Mono County.

Sonora Pass Lateral

Southwesterly from Sonora the Mother Lode Highway follows the Sonora Pass lateral to a point some six miles beyond Jamestown; there it takes off in a southeasterly direction through Chinese Camp, Moccasin, Coulterville and up into the mountains by way of Bagby and Bear Valley to Mariposa. Between Chinese Camp and Moccasin the Big Oak Flat road leads off toward the east and, traversing the northern half of Yosemite National Park, this lateral becomes the Tioga Pass Route over the Sierra. It crosses the divide at elevation 9,941, the highest crossing of the mountains on the state highways, from which point it twists down to a connection with U. S. 395 near Leevining on Mono Lake. Bret Harte's old cabin is situated near Groveland on the Big Oak Flat Road.

Those familiar with the writings of Bret Harte will readily recall Poker Flat, Poverty Hill, Table Mountain, Whiskey Hill and Jimtown. These historic spots are all accessible from Jamestown.

Kings River Canyon

In highway development, scenic grandeur is usually accompanied by the heaviest of construction. Probably nowhere has this been better illustrated than in the building of the state highway into Kings River Canyon in Fresno County.

The Kings River National Park in eastern Fresno and northeastern Tulare Counties embraces an unrivaled wilderness of rugged granite and forest, and the Kings River Canyon leading to the park presents scenery which closely approaches that of Yosemite Valley in massive majesty.

The most direct state highway connecting this wild mountain fastness of California's high Sierra with the outside world is the road between Fresno and the General Grant Grove by way of Squaw Valley. The route leaves General Grant Grove on its northerly boundary and travels along the valley side of the lower Sierra to Cherry Gap. Passing through the Gap the first view is obtained of the rugged beauty of the lower Middle Fork of the Kings. A little further, at Lookout Point, a splendid panorama is had of the massive rock formations of the country along the South Fork and the relative positions of Ten-Mile Creek, the two forks and the main Kings River Gorge.

Scenic Beauty

Winding farther down the grade the highway rounds Yucca Point, an inspiring point of vantage, from which the view of the glacier-carved gorge justifies

the name given to the river by the Spaniards in 1805: "El Rio de los Santos Reys" (The River of the Holy Kings). On down over gentle grades and easy curves the highway is carved in the granite of the canyon wall finally reaching the river at Windy Cliff, some 18 miles from the General Grant Grove. Here the rock formation suddenly changes as a great limestone dike rises almost vertically to a height of 1,500 feet above the river. This limestone presents striking examples of natural sculpture. About 200 yards above the highway in the face of Windy Cliff is Patt Boyden's Cave, large galleries and grottoes filled with stalactites and stalagmites through which, from unknown sources, flow strong air currents.

Record Explosion

Building the highway around Horseshoe Bend presented the most difficult single problem in the road's construction. At this point the highway grade is some 300 feet above the river and its path was blocked by a rugged point of solid granite jutting over the river. While in all the construction of the Kings River Canyon explosives had played a most important part, the high point in operations was the removal in one blast of over 50,000 cubic yards from the face of this rock mass. A coyote hole four to six feet high was drilled along the gutter line of the roadway for a distance of 570 feet. Nine stub pockets were drilled off this tunnel toward the face to provide more advantageous placement of the powder, in all, a total of 745 feet of tunnel was drilled. The charge consisted of 37 tons (74,450 pounds to be exact) of explosive. After the charge had been placed the entire tunnel was carefully packed and backfilled with rock and earth to insure most effectiveness from the blast. In the one shot, 50,500 cubic yards of rock was moved from the face of the cliff, leaving a solid rock foundation on which to lay the road surface. The westerly 200 feet broke along a vertical seam leaving as clean a bit of construction as could have been desired.

At Windy Cliff, where the highway reaches the river elevation, the road crosses to the northerly side and follows on past Boulder and Grizzly Creeks to Deer Creek Cove where state construction ends. An additional four miles, however, was built by the U. S. Forest Service on to Cedar Grove, where a large area has been cleared among the trees and prepared with camping conveniences.

The State's portion of the Kings River Canyon project covered a distance of 24.5 miles and was built at a cost of $2,300,000, an expenditure which has provided Californians with easy access to some of the Nation's most beautiful mountain country.

U. S. 99

As previously stated, highway U. S. 99 is the central artery of the California State Highway System. As such it carries an unusually large volume of traffic, particularly heavy trucking.

U. S. 99 enters California from Oregon north of Yreka and travels southerly through the mountains and over Shasta Dam Reservoir to the Sacramento Valley at Redding. Between Red Bluff and Sacramento the route divides, following down both sides of the Sacramento River. That portion on the easterly side, designated as U. S. 99-E, passes through Chico, Yuba City, Marysville and Roseville and the westerly route, U. S. 99-W, passes through Corning, Willows, Williams, Woodland and Davis. From Sacramento, the route is laid out down the

Highway Expenditures Exceed Billion Dollars

In its first biennial report to Governor James H. Budd on November 25, 1896, the Bureau of Highways created by the Legislature on March 27, 1895, said:

"Exclusive of the sums expended on the streets of cities, towns, and even of many villages, nearly $2,000,000 were expended on the highways of the State of California during the Fiscal Year 1894-95. During the 11 years, from 1885 to 1895, such data as could be gathered from the records of the various county officials show that, not including private subscriptions of money, labor, material and poll tax paid for generally in labor previous to 1893, and cost of construction of numerous bridges, payment for which was taken in part or in whole out of funds other than those set apart for highway purposes, the highway expenditures of the State reached the enormous sum of $18,000,000."

What was considered in 1896 an "enormous sum" is paled by modern day annual budgets of the California Highway Commission. Almost $100,000,000 now is spent each year for construction of state highways, including right of way and engineering costs.

This is exclusive of highway expenditures made by the counties and the cities.

During the period July 1, 1911, to June 30, 1949, the California Division of Highways expended $1,258,335,603.37.*

For this same period, highway revenues and expenditures were as follows:

Income	
Bond issues	$74,112,243.50
Highway users taxes	938,581,471.63
State General Fund appropriations	27,865,754.71
Federal aid and reimbursements	230,624,849.51
Contributions	16,819,068.24
Miscellaneous	2,790,278.53
Total	$1,290,793,666.12
Expenditures	
Construction and improvements, state highways	
Rural	$628,374,676.30
Incorporated cities	190,319,724.63
Maintenance, state highways	
Rural	217,997,233.31
Incorporated cities	13,591,906.84
Construction and improvements off state system	
Rural	34,867,578.37
Incorporated cities	13,709,498.03
Subventions	
Counties	5,065,996.52
Cities (Section 194, S. and H. Code)	76,706,190.82
Adminstration, special investigations, highway planning	49,842,487.56
Equipment, plants, stores, etc.	25,084,979.33
Supervision of outdoor advertising	530,006.21
Flight strip construction for Federal Government	2,245,325.45
Total	$1,258,335,603.37

* These and other figures are as of June 30, 1949, as this is the last fiscal year for which data has been compiled.

middle of the San Joaquin Valley through Stockton, Modesto, Merced, Fresno and Bakersfield. South of Bakersfield, U. S. 99 crosses the Tehachapi Mountains over the Ridge Route at Fort Tejon and into the Los Angeles Basin via the San Fernando Valley.

From the southerly end of San Fernando Boulevard in downtown Los Angeles the route turns easterly along Ramona Freeway to Redlands where it turns southeasterly through Beaumont and the San Gorgonio Pass to Indio, through the Coachella Valley and along the westerly side of the Salton Sea to El Centro, terminating at Calexico on the Mexican border.

Continuous Development

Development of this central artery of the State Highway System, like all main highways where traffic volumes have increased steadily, has been a continuous operation since the inception of the system. Similar to all highway construction, improvement projects on this route were deferred during the war until the close of hostilities when the Division of Highways put under way its postwar construction program.

The impetus given to development of California highways following the war with state funds accumulated during the years of 1942 to 1945 and federal funds apportioned to the State under provisions of the Federal Aid Highway Acts of 1944 and 1948 has been carried forward during the last five years and under provisions of the Collier Burns Act it has been possible to accelerate this rate of construction progress.

Heaviest Traffic Volumes

While postwar development of the route has extended over portions of its entire length the greater part of modern improvement has taken place between Sacramento and Los Angeles, where traffic volumes are the heaviest. The aim of present day construction programs on this highway is for a continuous four lane divided expressway from Los Angeles to Sacramento, interspersed with four and six lane freeway sections through metropolitan areas.

With the exception of the widening of continuous sections of the Ridge Route to four-lane divided standards the method followed in expressway development has been to work out in each direction from the various cities and towns with a series of contracts until the improvements form a complete expressway. This method is now beginning to show satisfactory results in the movement of traffic by elimination of congestion at the approaches to cities. Stockton is completely bypassed by a freeway; Modesto, Merced, Madera and other towns no longer present the bottlenecks of prewar years. The Bakersfield area is completed to expressway standards and development in the Fresno area is about half completed.

ANTI-ROAD SIGN MOVEMENT

Judging from the general tenor of newspaper comment, public sentiment throughout the State is warmly in sympathy with the movement started by the Civic Section of the California Federation of Women's Clubs of the Northern District for the protection of the State Highway System against the hideous road sign which obliterates the landscape and mars the beauty of the scenery along nearly all of California's highways.

Mrs. Bradford Woodbridge of Roseville, Chairman of the Civic Section, and Mrs. George W. McCoy of Placerville, President of the Northern District of the Federation, are leading in this aggressive campaign.

It is needless to say that the California Highway Commission endorses the movement which these public-spirited ladies represent.—*From California Highway Bulletin, October, 1912.*

Upon completion of contracts now in progress that portion of U. S. 99 from Los Angeles to McFarland, 25 miles north of Bakersfield, will be continuous multilane highway. This is a distance of 135 miles and, with the exception of a three-lane section through Weldon Canyon just north of the San Fernando Valley, it will all be a divided four lane expressway.

The Ridge Route

From an engineering standpoint the widening to four-lane divided standards of the "old" three-lane Ridge Route, where U. S. 99 crosses the mountain ranges of granite wasteland which divide the Los Angeles Basin from the San Joaquin Valley, was the most difficult of all postwar improvements to this central arterial, particularly the section through Piru Gorge which is now underway. Involving movement of large quantities of material from steep mountain sides, construction of high fills and widening of bridges in cramped quarters, while at the same time keeping the heavy traffic moving, this work has more than presented problems to both highway engineers and contractors.

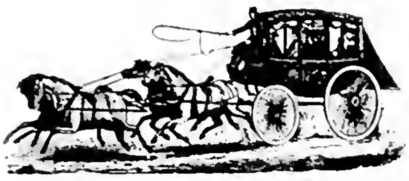
The original Ridge Route, constructed in 1914, was 48 miles of tortuous, narrow mountain road. In 1933 work began on what was called the "Ridge Route Alternative," which reduced this 48 miles to 37 miles. It is on this latter routing that the current widening program has been in progress. The story of the building of the "Alternative" made construction history and while it has been told before, it remains one of the highlights in development of the California State Highway System, therefore the following few paragraphs, taken from an article written some years ago, have been resurrected, dusted off and added to this 1950 story of Highways of California.

Probably nowhere in the State has the hand of the locating engineer been so ruthless in slashing through on modern alignment, as on the relocation of the Ridge Route, U. S. Highway 99, between Los Angeles and Bakersfield. Probably nowhere in the State is there a better example of the evolution of modern highways since the advent of the motor car.

What a Difference!

Prior to 1933, the motorist traveling from Castaic northerly to the floor of the San Joaquin Valley labored and fretted through 48 miles of narrow, tortuous mountain grades culminating in the hairpin turn of the infamous "Deadman's Curve" in Grapevine Canyon. Today he travels only 38 miles between the same points, speed-

1849



PAST

Appeal for State Highway along the Old Pioneer Route from Sacramento to Placerville via Folsom, Clarksville, Shingle Springs, El Dorado, and Diamond Springs.

OLD PLACERVILLE & SACRAMENTO

PIONEER EMIGRANT ROAD CLUB

1911

PRESENT

1915

FUTURE

?

Photo at bottom of page is one of the answers to the question mark on this old drawing

ily and safely, unhindered by sharp curvature and unhampered by slow climbing trucks.

The record of this development as shown by comparison of data on the old and the new routes indicates most clearly the great degree of improvement.

	Old Route	New Route
Length, miles	48.36	37.57
Width, lanes	2	3
Maximum grade, percent	6	6
Minimum radius curve, feet	70	1,000
Total curvature, degrees	39,441	3,070
Curvature equivalent in circles	109½	8½
Highest elevation, feet	4,234	3,550
Adverse fall, feet	2,220	1.040

Some Answers

With such improvement possible, the questions naturally arise; why wasn't the latter location chosen in the first place? Why wasn't the earlier road built to better standards? A trite answer might be: Why weren't 1914 cars built like those of today? But the reason is much more complex. Even as far back as 1914 when the original Ridge Route was constructed, the engineers knew that a better road could be built. The degree of perfection of any highway in such mountainous terrain, however, is dependent upon an economical balance between costs, money available, and justifiable expenditure.

Many factors require consideration, such as relative distances, grades, traffic volumes, speeds and types of traffic. For traffic of that day, when there were less than 126,000 cars in the entire State and 35 miles per hour was "wide open," such an investment, as the present road would have entailed, was not justified. Indeed, it would have noticeably depleted money available for improvement elsewhere in the State, at a time when the main objective was to "get out of the mud." So the much more difficult location, later selected for the alternate, was avoided and the original route was built along the ridge to standards typical of mountain highways of that time, following the contours in order to save grading costs.

Steady Traffic Increase

The old highway served for many years. As traffic increased, the sharpest curves were widened and daylighted, but by 1929 the volume had reached such proportions that further improvement of the old route would have been uneconomical. Reconnaissance surveys and economic studies revealed that a complete new three-lane highway would pay for itself in savings to motorists within 2½ years; finances, however, did not permit immediate construction of the entire project.

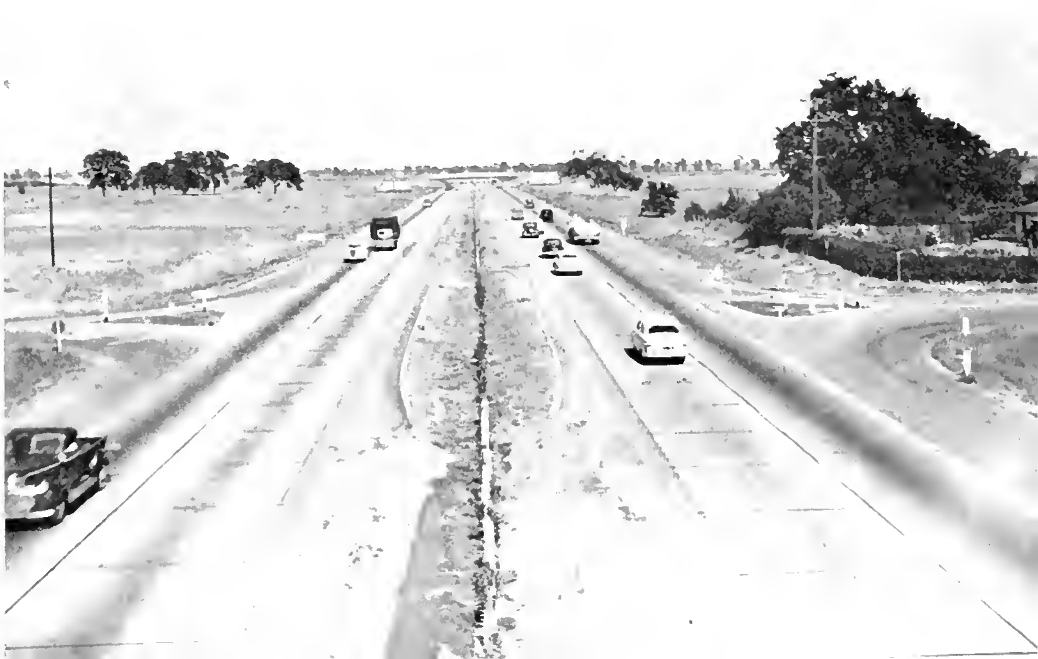
Work on the first unit was begun early in 1930. By late 1933 the 27-mile Ridge Route Alternate between Castaic and Gorman was open to traffic and by 1936 the last unit of the Grapevine relocation was completed.

Some of the new route's features were: Eight major bridges, four across Piru Creek alone; several miles of channel changes; 5,000,000 cubic yards of excavation; and costs totaling more than 5½ million dollars—are answers as to why such a road could not have been considered in 1914.

Earth Moving Problems

While the total of 5,000,000 cubic yards of excavation is an indication of the over-all size of the grading contracts, a better idea of the enormity of some of

North Sacramento Freeway. Approach to state capital on U. S. 40 from east and U. S. 99-E from north



the earth-moving problems encountered may be had from the fact that, within a center line distance of only 400 feet in Piru Gorge, excavation required the removal of 230,000 cubic yards of material. Literally, that was moving a mountain.

Traffic increased prodigiously with the breaking of the old barrier, both in passenger cars and long haul trucking. From 2,500 cars and trucks daily in 1933, the volume rose to 4,800 in 1936 and to almost 6,000 by 1941.

Most of the new road was fully adequate for this volume and more, but the Grapevine was not. Its nearly six miles of continuous $5\frac{1}{2}$ percent grade, with an abnormal uphill speed differential between fast traffic and heavy trucks (20 percent of the total), and frequent runaway trucks made the Grapevine again one of the most hazardous sections of highway in the State.

Highway Widened

To remedy the condition, this section was widened in 1942 and 1943 to four lanes, divided for nearly four of its six miles by a heavy steel barrier rail, and with 3,000 feet of heavy concrete curb on the downhill shoulder to act as a snub for runaway trucks—this protection may be rough on tire sidewalls, but it is effective.

At the same time a badly saturated hillside, the scene of many slides which threatened to carry the roadway into Grapevine Canyon was corrected in an unusual manner. A buttress consisting of 180,000 cubic yards of fill was placed on the bottom of the canyon to act as a counterweight in balancing earth pressures exerted by the unstable hillside, and numerous perforated pipes were driven as much as 170 feet into the hill above the highway as drains for ground waters.

Such is the history of the Ridge Route.

Freeway Construction

South of Los Angeles to the Mexican border postwar construction on U. S. 99 has been confined almost entirely to expressway and freeway construction: units of Ramona Freeway between Los Angeles and Pomona; Colton; Redlands; Beaumont; and down in Imperial County, all improvements to the central artery of the State Highway System.

As a gauge to the size of current development to U. S. 99 in California the following shows construction expenditures and miles of construction on this route between the end of World War II and June 30, 1950.

Oregon to Sacramento—$14,500,-000—339 miles of construction.

Sacramento to Los Angeles—$33,-700,000—376 miles of construction.

Los Angeles to Mexican Border—$19,200,000—147 miles of construction.

All of which totals $67,400,000 and 862 miles of highway construction.

U. S. 101

Of importance to the economic welfare of California practically equal to that held by U. S. 99 is the coastal north-south artery designated as U. S. 101.

This highway crosses the north state boundary between Gold Beach, Oregon and Crescent City, California, and, as the Redwood Highway, generally follows the coast line to the south end of Humboldt Bay where it turns inland and follows the Eel River for most of its length. Progressing southerly toward San Francisco, it passes through the cities of Willits, Ukiah, Santa Rosa, Petaluma, San Rafael, and Sausalito to the Golden Gate Bridge.

Between San Francisco and San Jose the route is divided into U. S. 101 and U. S. 101 Bypass, the Peninsular Highway and Bayshore Highway respectively. After passing through the Santa Clara Valley, through San Jose and Gilroy it enters the Salinas Valley and roughly parallels the Salinas River through King City to Paso Robles and Atascadero; crossing the Coast Range both north and south of San Luis Obispo it passes through Santa Maria where it heads for the ocean shore through Solomon Canyon and Gaviota Pass from where it follows the shore line through Santa Barbara and San Buenaventura to El Rio Junction.

Again Divided

At El Rio, it is again divided as U. S. 101 and U. S. 101 Alternate, the former turning inland along the westerly side of San Fernando Valley (Ventura Boulevard) to Hollywood and central Los Angeles. In East Los Angeles, the route is further divided into U. S. 101 and U. S. 101 Bypass with 101 following Whittier Boulevard easterly to Fullerton Road where it turns south through Anaheim, Santa Ana and San Juan Capistrano to Doheny Park on the ocean. The Bypass turns off U. S. 101 near the east city limits of Los Angeles and follows along Anaheim-Telegraph Road, Firestone and Manchester Boulevards to join 101 again near Anaheim.

U. S. 101 Alternate turns at El Rio Junction to the coast via Oxnard and follows the shore line through the westerly fringe of Los Angeles and the beach cities to join 101 again at Doheny Park. The larger of these beach cities include Santa Monica, Redondo Beach, Long Beach, Newport Beach and Laguna Beach.

From Doheny Park U. S. 101 follows the coast line to San Diego and the Mexican border at Tiajuana.

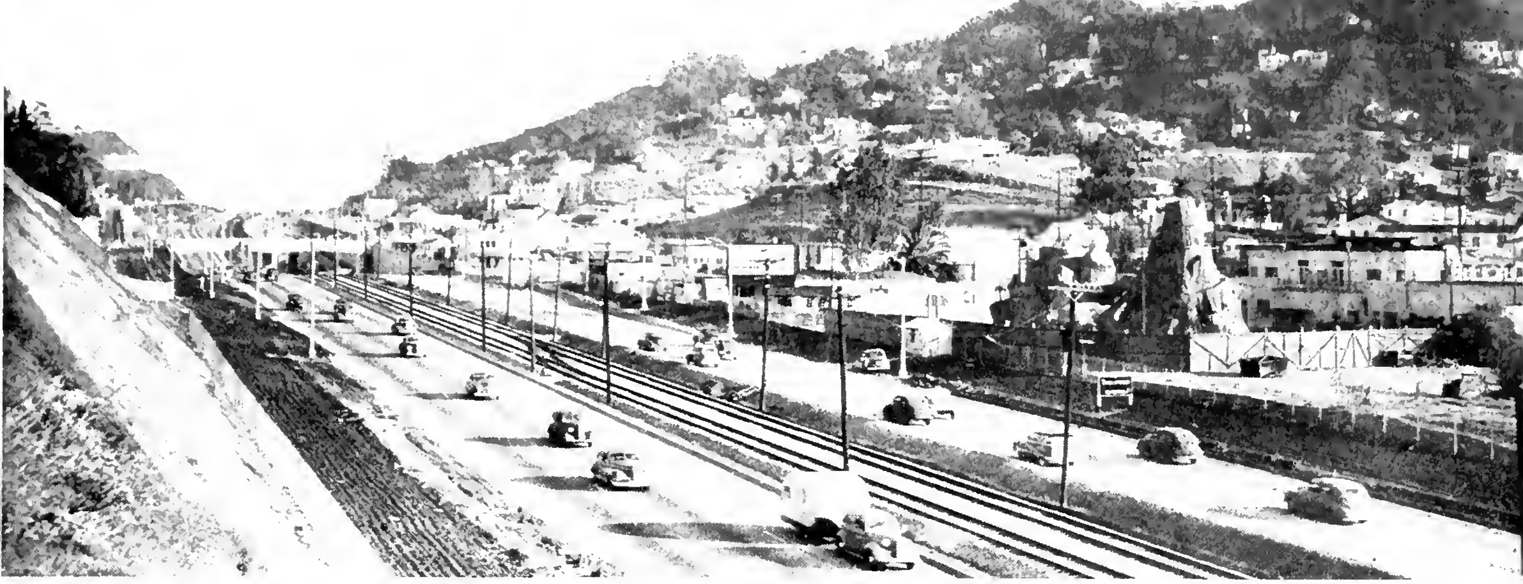
Current Development

Current development of this arterial highway from San Francisco south has been programmed on a pattern similar to the improvements to U. S. 99 between Sacramento and Los Angeles. Again, the goal is construction to expressway standards over the entire distance from the Mexican border to San Francisco, interspersed with freeway development through metropolitan areas.

On the peninsula, construction to freeway standards on the Bay Shore Highway (U. S. 101 Bypass) is advancing rapidly. From South San Francisco to San Mateo over 11 miles of six-lane freeway is in use and construction operations are progressing rapidly within the City of San Francisco between Alemany Boulevard and 25th Street.

Hollywood Freeway

In Los Angeles the Hollywood Freeway is in use through Cahuenga Pass from Highland Avenue to Lankershim Boulevard and on the Santa Ana Freeway traffic is moving from Aliso Street to the east city limits. Freeway construction is rapidly advancing towards completion on the Hollywood Freeway from Main Street to Western Avenue with all but one or two structures in place and the six-lane pavement is rolling out block after block.



UPPER—Cahuenga Freeway in Los Angeles. CENTER—New freeway on U. S. 101 in Buellton. LOWER LEFT—Santa Ana Freeway, Los Angeles. LOWER RIGHT—Joshua trees add beauty to U. S. 66 between Cajon Summit and Victorville, San Bernardino County

UPPER—Cabrillo Freeway in San Diego looking northerly toward Mission Valley. LOWER—Cabrillo Freeway looking southerly toward downtown San Diego

Other going contracts and budgeted projects will complete most of the Santa Ana Freeway south to Miraflores.

Freeway construction has been completed at Santa Barbara and Buellton and construction to expressway standards has been completed or is under way in the San Fernando Valley; at Ventura; north of Santa Barbara; at Pismo Beach; both north and south of San Luis Obispo; at Salinas; through San Benito County; and between Gilroy and San Jose.

In San Diego County, similar expressway construction has been completed or is under way, within the City of San Diego, through Chula Vista and from National City to the border.

Most of U. S. 101 Alternate along the coast in both Los Angeles and Orange Counties is built to four-lane divided expressway standards.

Accelerated Program

Complete development of U. S. 101, its Bypasses and the Alternate, to expressway and freeway standards is as monumental a task as is the similar improvement to U. S. 99.

However, under the expanded state highway construction program made possible by the Collier-Burns Highway Act and federal funds from the Federal Aid acts of 1944 and 1948, the Division of Highways has made more than considerable progress in development of this route throughout its length from the Mexican border to the Oregon line.

While it has been impossible in this brief article to list the individual contracts and projects which have gone into this development, the following summary of expenditures since the end of World War II indicates the progress being made under the accelerated construction program.

Section	U. S. 101 Expenditures Oct., 1945, to June 30, 1950	Construction, miles
Oregon Line to San Francisco	$11,600,000	166
San Francisco to Los Angeles	50,800,000	207
Los Angeles to Mexican Border	28,400,000	133
Totals	$90,800,000	506

The latter part of this article started out to be a compilation of intimate stories in connection with construction of various state highways, but the development of main arteries such as U. S

40, U. S. 99 and U. S. 101 is construction of such magnitude that the intimate yarns seem lost among multitudinous engineering projects. So that the reader may finish with a feeling of closer relationship toward the work of the Division of Highways and its engineers, may we add two brief descriptions of unrelated state construction projects of some years past.

Death Valley

Of all natural attractions within the boundaries of California, the world famous Death Valley in southeastern Inyo County is undoubtedly the most unique. The first recorded story of this ominous wasteland of awesome beauty came from Lewis Manly, who early in 1850 led the remnants of the "Jayhawker" emigrant train over the west side escarpment formed by the towering Panamint Range. The survivors of that ill-fated party from Kansas paused on the summit of the range to look back on the land of their trial, suffering and death, only long enough to bestow upon that desert sink the fitting name of "Death Valley."

By Presidential Proclamation in 1933 some 2,500 square miles of desert mountains and valley were set aside as the Death Valley National Monument. Included within the monument boundaries are the 400 square miles of Death Valley proper, a flat, dry, seabed hemmed in by the 6,000-foot Amargosa Range on the east and on the west by the precipitous Panamint Range, where elevations such as the 11,045 feet of Telescope Peak tower above their base as do no other peaks in the United States.

Valley Below Sea Level

Nearly the whole floor of the valley lies below sea level, with the minus-276 elevation at Bad Water marking the lowest point in the United States. The sea level contour encloses an area more than 70 miles long and from one to six miles wide.

The winter temperature in Death Valley is ideal. The summer climate is something else. Accurate meteorological data in Death Valley has been accumulated only in recent years. A temperature of 134 degrees in the shade has been recorded at Furnace Creek Ranch. It should be noted, however, that, that was

Freeway construction on U. S. 99 at Fresno showing California Avenue overhead in foreground and Monterey Avenue overhead in background

the limit of the thermometer. Geological Survey documents indicate that a temperature of 150 degrees has been observed around the stone beds at the mouths of several canyons and out on the salt beds it is estimated the temperature will go 10 degrees higher. The average annual temperature of 75 degrees would indicate a most delightful climate, was it not that the range included in computing this average runs from 15 degrees to 134 degrees.

Discovery of Borax

Following the '49 "Jayhawker" emigrants, prospectors were lured into the ranges surrounding the valley by stories of gold, silver, and lead deposits, the wealth of which would stagger the imagination. These fabled deposits are still missing and still sought. The prospecting, however, did lead to other mineral wealth, such as the discovery of borax, which resulted in the construction of wagon roads, a railroad, and the gradual development of the area to its present status. In this connection, the "Twenty-Mule Team" trademark probably has given Death Valley more widespread publicity than any other single factor.

Because of the highly mineralized nature of the valley, its formations are fantastic and colorful in the extreme, providing most interesting and entertaining scenes.

Prior to its incorporation into the federal system of national parks and monuments, there were several so called roads throughout the valley. These roads which usually followed the bottoms of washes as the most convenient location were quite regularly obliterated by summer cloudbursts.

Highway System Enlarged

At about the time the Death Valley National Monument was created, the 1933 Session of the California State Legislature added to the State Highway System some 6,600 miles of roads. Included in these additions were two highways serving as the main entrances to the valley. One of these extended along the east side of the valley from Baker in San Bernardino County through Death Valley Junction; the other, provided a westerly approach from Lone Pine through Darwin.

Improvement of the entrance via Baker and Death Valley Junction involved only typical desert construction, and aside from usual desert drainage problems presented no serious difficulties. The road in from Lone Pine was quite another matter.

From a connection with U. S. 395 about two miles south of Lone Pine, the old road traveled southeasterly through Keeler on the dry Owens Lake bed, to

Darwin. This road had long served the mining properties in this section.

Toll Road Built

In 1926, H. N. Eichbaum, a pioneer resident of the Death Valley country, secured from Inyo County, a franchise to build and operate a toll road from Darwin to Death Valley. He built his road along an old trail following down Darwin Wash, in the Argus Mountains, across Panamint Sink, over the Panamint Range by way of Towne's Pass and thence down to Stove Pipe Wells in Death Valley.

For the privilege of driving the 31 miles of this narrow dusty road, 20 miles of which was crooked and precipitous with grades of from 15 to 20 percent, the traveler paid a toll of $2 per car and 50 cents per person.

As soon as the Legislature had incorporated in the State Highway System a westerly route into the valley, the Division of Highways began negotiations for acquiring the Eichbaum franchise, which, by way of interest, extended into perpetuity. On December 20, 1934, the deed vesting title in the State was filed and tolls abolished.

Darwin to Zinc Hill Grade

In the meantime, reconnaissance by state highway engineers developed a line connecting with the old route some distance north of Darwin and following northeasterly along the ridges, in lieu of washes, down the side of Rainbow Canyon to a connection with the old toll road at the floor of Panamint Sink where Darwin Canyon debauches into the sink. The routing, while it involved difficult rock construction, eliminated the tortuous descent of the Zinc Hill Grade in Darwin Wash. In former days the road down Zinc Hill was subject to annual obliteration by cloud bursts.

The distance on the old road from the point of connection north of Darwin to that at the foot of Zinc Hill Grade was 19.9 miles and included 245 curves. On the present highway the distance is 17.5 miles with only 72 curves. The total difference in curvature between the 245 and the 72 curves was more than 8,950 degrees or nearly 25 complete circles; the curves on the old road were also much sharper than those on the revised alignment, the minimum radius on the old route being only 30 feet while on the new, the minimum radius is 200 feet. Easterly from the mouth of Darwin Wash, improvement to the route was considerably less difficult. Across the Panamint Sink the going was straight and through Towne's Pass the old alignment was satisfactory. The remainder of this western entrance into the monument to its connection with the Park Road System lies across the flat valley floor and is an excellent highway.

Through regular improvement and maintenance on these two state highway entrances into Death Valley, motorists have been provided with the means of easy access to this awe-inspiring portion of California.

The Yuma Sand Hills

Crossing the southeasterly corner of Imperial Valley and lying to the west of the Yuma Indian Reservation is a ribbon of continually shifting sand dunes usually referred to as the Sand Hills, or to be a little more specific the Yuma Sand Hills. The northeasterly end of these Sand Hills is located near Niland and the southwesterly end is south of the border in Mexico.

This plank road carried vehicular traffic across the Yuma sand dunes west of Open Valley in Imperial County for many years following its construction in 1915-16. Note plank turn-out for traffic on left

Since the earliest days of occupation in Southern California, travel across the Imperial Desert has followed a trail through these Sand Hills. The route has always been popular as a link in the most southerly transcontinental route. At intervals throughout the year, strong winds from the northwest blow across the dunes resulting in a constant movement of the Sand Hills to the southeast.

One peculiarity of the Sand Hills country is that in the middle of the dunes is a small level "Open Valley" about one half mile wide and 1¼ miles long which is free from sand drifts. This valley apparently has remained in the same place for many, many years, for as late as 1924 there were in place in the valley several old telegraph poles which were reportedly placed there in 1857 by General John C. Fremont as a part of a pole line across the desert.

Information is quite vague relative to any improvement of the Sand Hills section of the desert road in the early days when San Diego County extended to the Arizona line or even after the formation of Imperial County in 1907.

Wooden Plank Road

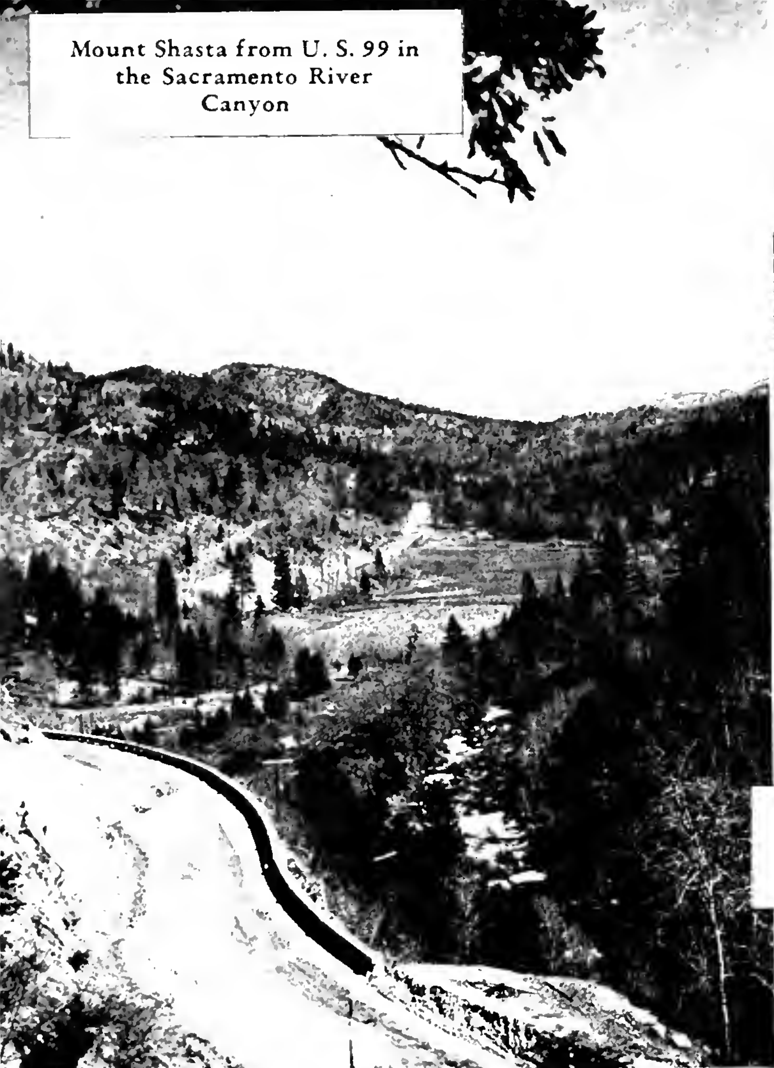
In 1916 the California Highway Commission in building the state highway between Yuma and El Centro constructed about 6.5 miles across the ever-moving Sand Hills. From the old "county well" on the westerly edge of the hills a wooden plank road, eight feet wide, was laid on the shifting sands to the westerly end of Open Valley. Through the 1¼ miles of Open Valley a 10-foot roadway was oiled and from the easterly end of the valley to Ramanda at the east edge of the Sand Hills another three miles of plank road was laid on the sand.

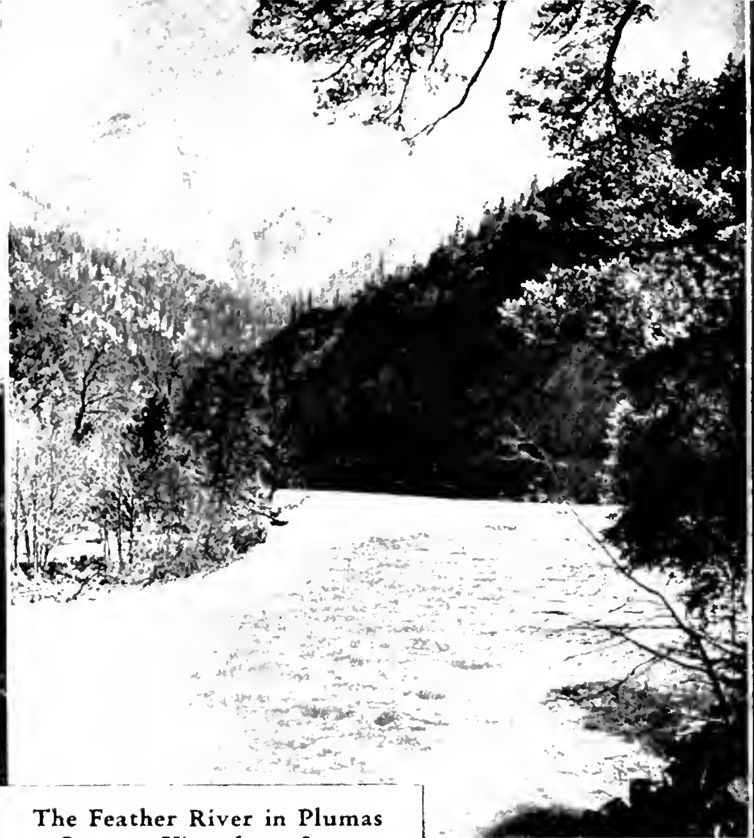
This unusual eight-foot plank highway, with its passing turnouts spaced at convenient intervals, or inconvenient to the motorist who had to back-up, served desert travelers for many years. The chief maintenance operation along the plank road consisted of scraping the drifts to the lee side with a team and fresno.

Bayshore Freeway in San Mateo County showing Cloverleaf Overcrossing to San Francisco Airport

Eastshore Freeway in Oakland—looking easterly—showing 19th Avenue Overcrossing in foreground and 23rd Avenue and 29th Avenue Overcrossings in background

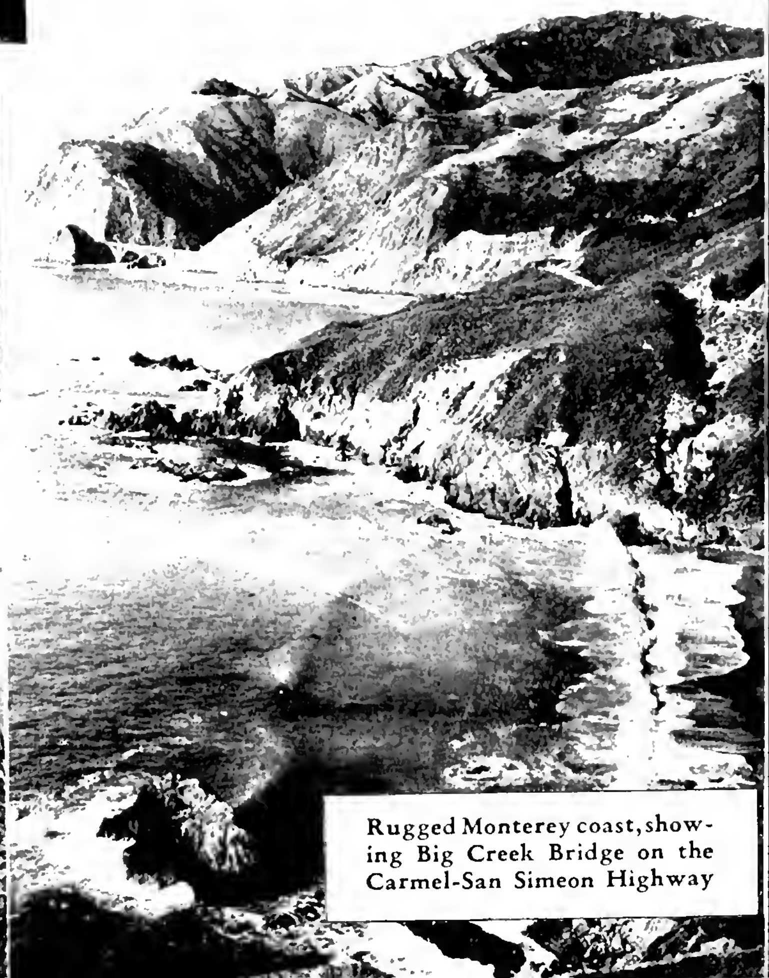
Mount Shasta from U. S. 99 in the Sacramento River Canyon





The Feather River in Plumas County. View from State Sign Route 24

The gem of the High Sierra—blue Lake Tahoe—reached by state highways



Rugged Monterey coast, showing Big Creek Bridge on the Carmel-San Simeon Highway

New Plank Highway

In 1924 a new and improved plank highway was laid on two 1,000-foot sections to replace splintered and weathered portions of the old road. The new design consisted of heavy redwood timbers separated by blocks and fastened together with long bolts. This type was considered better than the old flat plank sections held together along the edges with longitudinal boards and wire.

During the years which the two sections of plank highways were serving desert traffic, the State Highway Department was learning quite a bit about desert road construction. In 1926, in order to provide facilities through the Sand Hills which were comparable with other desert highways, 6.5 miles of asphalt concrete pavement were placed on a new grade line as replacement of the old plank road.

The method adopted consisted of constructing a 30-foot graded roadbed to an elevation which corresponded to the tops of surrounding dunes. The fill was constructed of the only material available: the blowsand of the dunes. While no unusually hard winds were experienced during the contract, the movement of the sand was so continual that it was necessary to take the cross-sections for determination of contract pay-quantities immediately behind the draglines placing the embankment.

Unusual Items

In fact, a review of this contract revealed three unusual items: "First Blow Off," "Blow On" and "Second Blow Off."

"First Blow Off" was material which was placed in the allowable embankment, but which, because it was "Gone with the Wind," had to be replaced once.

"Second Blow Off" was material in the allowable embankment which had to be replaced twice, and

"Blow On" was material which was blown onto the embankment after construction and which had to be removed by the contractor before the embankment slopes were oiled.

How the resident engineer and his assistants kept their quantity records for this "put and take" game with blowing sand and at the same time kept their sanity is difficult to imagine.

As rapidly as possible, subgrade was shaped behind the draglines, header boards lined up and the base course of the 20-foot asphalt concrete placed. This required laying planks on the subgrade for travel of the trucks carrying the hot asphalt concrete. As the planks were removed steel plates were laid to support the trucks while dumping.

No difficulty was encountered in laying the surface course, except that the continual deposit of drifting sand required a small crew with hand brooms steadily sweeping up the base immediately in front of placing the top course.

While these construction operations must have left the boys on the verge of nervous collapse, it was a good pavement and undoubtedly the most stable thing in the Sand Hills—it and General Fremont's telegraph poles.

Such are a few of literally hundreds of intimate and interesting stories connected with one hundred years in development of California highways. From oxcart trails to metropolitan freeways is as far a cry as from an Indian "Wickiup" to the Ambassador or Biltmore Hotel in Los Angeles and California has seen both during its first century as a State.





Chapter XV

Century of Bridge Progress

I. W. Panhorst, Assistant State Highway Engineer (Bridges)

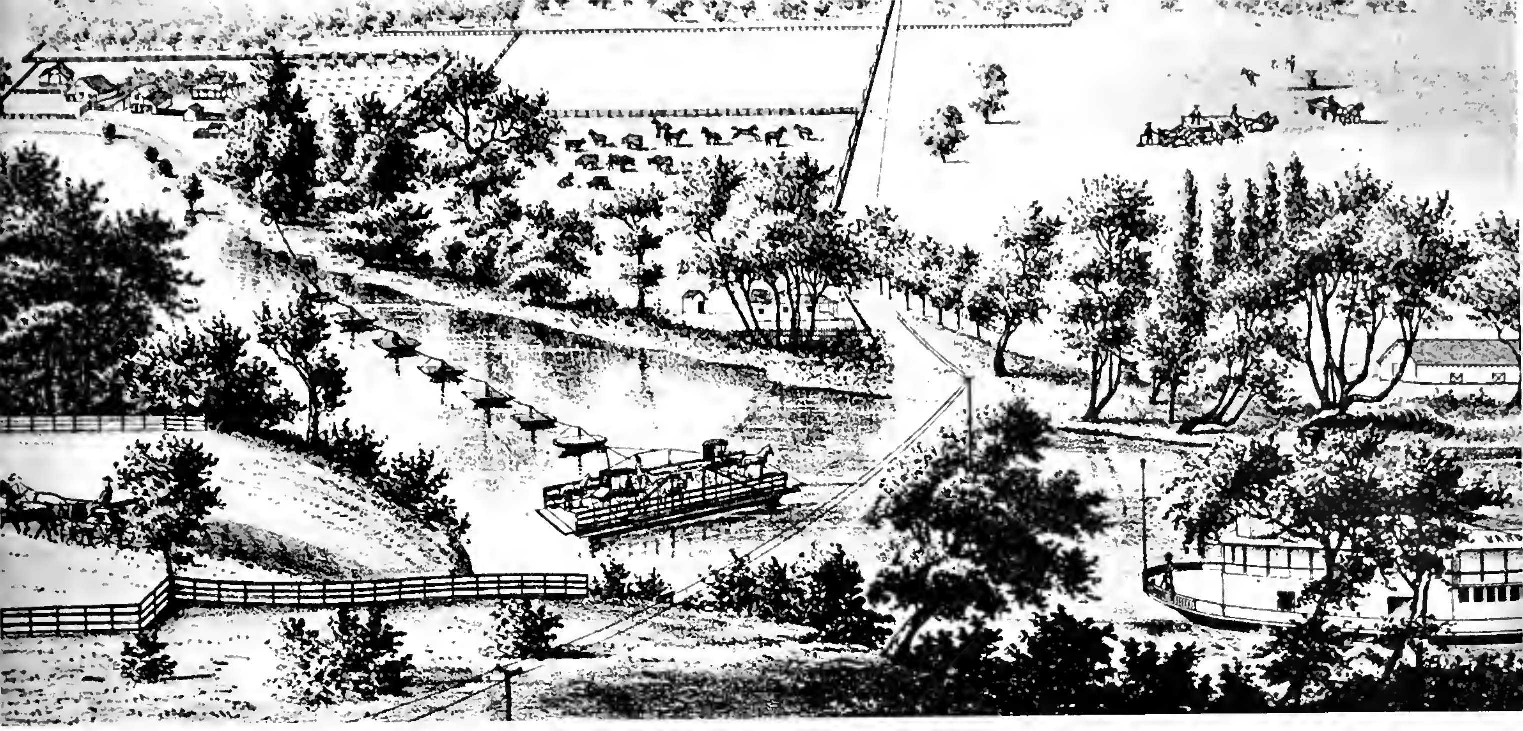
California 100 years ago was a pioneer country served primarily by waterways from which primitive roads and trails led to settlements at missions, ranchos and placer mines. Land routes had been located so as to avoid natural obstacles, often detouring many miles to reach the best passes over hills and streams. The channels crossed by El Camino Real were dry most of the year and fordable except after heavy rains. The emigrant roads were little more than trails, such that wagons had to be unlimbered to pass declivities and major streams. Roads to the new placer diggings were developing rapidly, but still following ravines and spurs. So, except for two minor structures, there were no bridges in 1850.

One of the exceptions was a stone slab bridge or culvert built about 1813 on El Camino Real over an aqueduct at Mission La Purisima Concepcion and still standing in La Purisima State Park (*See illustration*). The other was the Hinckley Bridge built in 1844 over the tidal inlet to Laguna Salada in Yerba Buena (now San Francisco), near the present intersection of Montgomery and Jackson Streets. Attesting to the lack of bridges in those days, William Heath Davis reported (Sixty Years in California, p. 208) that "people came from far and near to look at and admire * * * the remarkable structure."

No Bridges in 1842

Davis made it very clear (p. 257) that "There were no bridges in those days," describing his trip to San Jose in 1842 when his horse had to swim Alameda Creek and he waited two days for Coyote Creek to fall. Again in 1847 (p. 435) his horse barely forded Santa Ana River and had to swim the San Gabriel. Fremont came down the American River to Sacra-

CALIFORNIA'S OLDEST BRIDGE—*Probably the oldest bridge in the State is that built b the Padres to carry El Camino Real over an aqueduct at Mission La Purisima Concepcion i Santa Barbara County. Ten feet wide and spanning only 1.5 feet, it consists of stone slabs o cemented stone abutments and is now preserved in La Purisima State Park. After destructio of the first mission by earthquake in 1812, work commenced on the new mission in 1813 The aqueduct and this little bridge were built shortly thereafter, 137 years ago*



Moon's Ferry across Sacramento River near Colusa, licensed in 1867. It was propelled by the current, using rudder and buoyed anchorage to hold barge obliquely

mento in 1844 and left via Walker Pass, fording with difficulty every Sierra stream from the American to the Kern.

However some streams could not be forded except for short periods of extreme low water and ferries were already being built and operated. The first, in 1843, crossed the Sacramento at what is now Knights Landing, and the Feather at Nicolaus, each being anchored with a long rope so as to utilize the current of the river for propulsion. These were replaced in 1849 by the Fremont-Vernon (now Verona) ferry on the Benicia-Marysville road, by which time there were ferries over the Sacramento and American Rivers at Sacramento City. The type is illustrated by Moon's Ferry of somewhat later date. Many other ferries were established in 1849-50, notably at Jacksonville on the Tuolumne and at Condemned, Murderers and Rattlesnake Bars on the American. Generally these were makeshift flatboats, rafts or even old wagon-beds, but the tolls were just as high.

From this brief summary of stream-crossing facilities in 1850, it will be apparent that practically all bridge construction in California must be included in this "century of progress." There has been progress in number, size, strength, materials, utility, economy and beauty of bridges, and in their safety for traffic and security against flood. Every one of some 30,000 bridges built in 100 years has marked a step in that progress. The story of 30,000 bridges can be told only by discussing them in groups represented by typical structures.

Eras of Bridge Construction

Not by any measure has progress been steady. Bridge building fluctuates with the prosperity of the community, the availability of materials, the traveling habits or desires of the people, and with the political economy of the times. Bridge design progresses with advancement of the arts and sciences generally, and with the education, training and experience of professional engineers specializing in bridges. These factors caused major and minor eras of bridge construction in the century. Some were distinct and some overlapped, but three periods were so outstanding in their impact on bridge progress that they will be treated separately. They will be called:

***The Pioneer Era* (1850-1875), marked by extension of the system of unimproved roads for pack train and wagon, and bridge building by private enterprise, using native materials to carry light loads.**

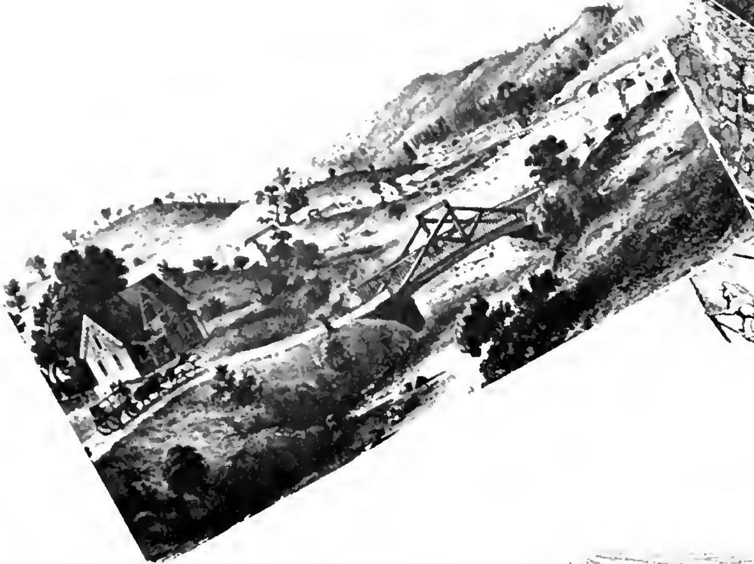
***The Railroad Era* (1875-1915), marked by expansion of the railroads to a position of economic and political dominance; railroads built the major bridges and made eastern steel available.**

***The Highway Era* (1915-1950), marked by construction of highways by public enterprise as the automobile supplanted the horse and the truck challenged rail freight; accelerated by discovery of petroleum, growth of population, two world wars and progressive prosperity.**

The Pioneer Era

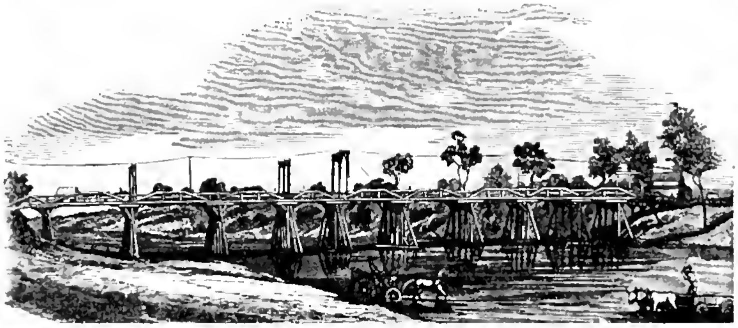
As the century began, California had been a pioneer region for 300 years. Even with statehood, it was still "around the Horn" from the other states, establishing its own law and order over a region turbulent with Indian skirmishes, disputed land titles, and conflicting mineral rights. This isolation restricted bridge building to the use of native materials (timber and stone), or to a minimum of metal for tension rods and cables. Much of California is still pioneer country, but for the State as a whole the era ended with the completion of the Central Pacific to the east and Southern Pacific lines to north and south in the 1870's.

In one respect the era should be divided into two equal periods by the great flood of 1862. Few bridges withstood the forces of water and drift logs.



UPPER LEFT—Timber A-frame south of Jacksonville, built about 1850

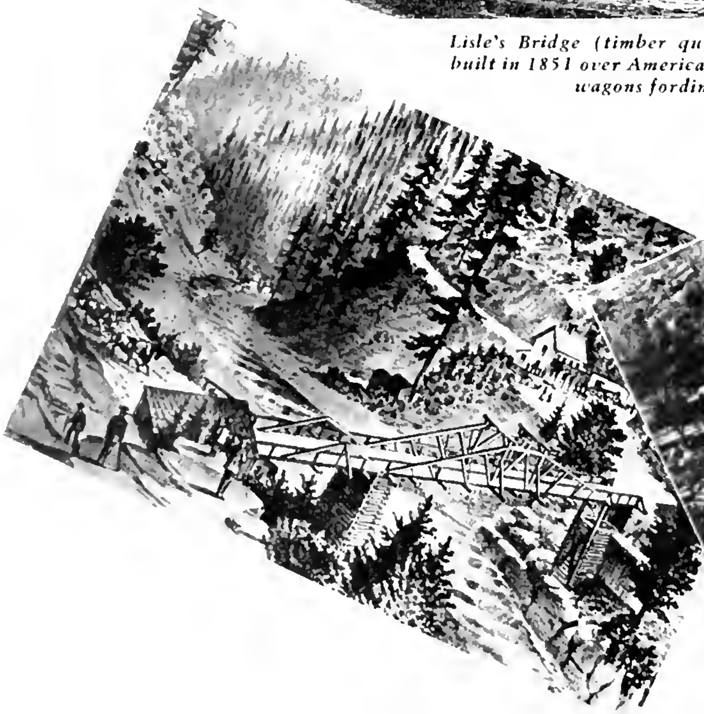
UPPER RIGHT—Timber A-frame on wagon road (foreground) and timber Burr truss on Central Pacific Railroad over Truckee River six miles east of Boca



Lisle's Bridge (timber queen-post and draw spans) built in 1851 over American River at Sacramento, and wagons fording to save tolls.

LOWER LEFT—Edward's Bridge (timber Fink truss on log cribs) over South Yuba River, built in 1862

LOWER RIGHT — Suspension bridge (built in 1865 and still standing) over American River at Rattlesnake Bar, with timber towers and canceled truss



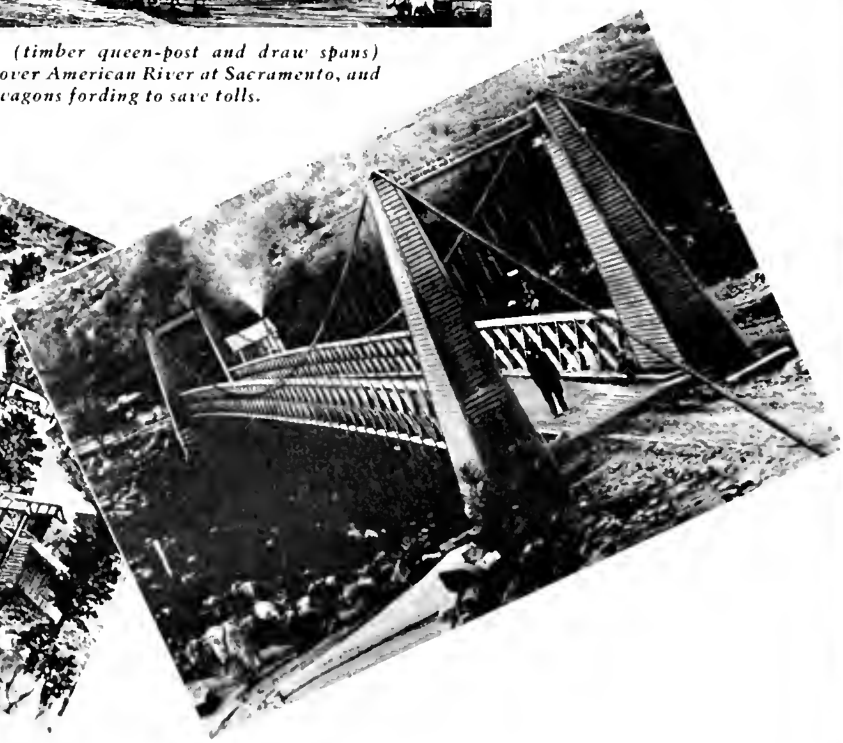


PLATE I
Typical Bridges of the Pioneer Era

Repair and reconstruction provided longer and higher spans, deeper and stronger foundations. But man's memory is short and the lessons learned in 1862 had to be learned again in 1884, 1916 and 1937-8.

Make-shift Bridges

At the beginning of the first period, there was frantic construction along routes to the Mother Lode. More ferries were launched on the larger rivers and makeshift bridges of logs, timber and cable were built over gorge channels. By 1852 timber trusses and cable suspension bridges had been constructed. Practically all were speculative ventures of private enterprise, but the rich returns on the investment led to construction of many more. Typical structures of the day are shown on *Plate I.*

No log bridges are shown, as these were simple structures that did not appeal to artists of the day and none is standing now. From old descriptions, they were usually single spans built from trees felled at the site. Some were single logs for pedestrians and led animals. Others were parallel logs supporting a cobble and gravel road bed. The most elaborate were parallel logs of one or two spans resting on log cribs and supporting a plank or corduroy deck. They were adaptable to pioneer construction using only axe, adze and maul to work materials at hand.

Timber Trestle Type

It was cheaper to haul hewn timbers than logs, so the timber trestle was a popular type in the unforested valleys. These were often jerry-built without adequate foundations or bracing. In 1851 a traveler reported that passengers were forced to disembark from the stage and walk across all the bridges between Sacramento and Marysville, "and then, so frail were these structures, that they trembled and swayed as the empty coach was being drawn over." In 1852 high water floated Stockton's first bridge off its piers and down to the bay, carrying with it a pedestrian who was rescued by townspeople.

Judge Palmer's Bridge over the Mokelumne River built in 1852 at Lancha Plana was just such a flimsy trestle on framed bents. It was variously reported as having failed after the first cart crossed or at the first rain. Another on the Mokelumne was built of lumber so green that it shrunk and dropped into the river the following summer.

First Pile Trestle

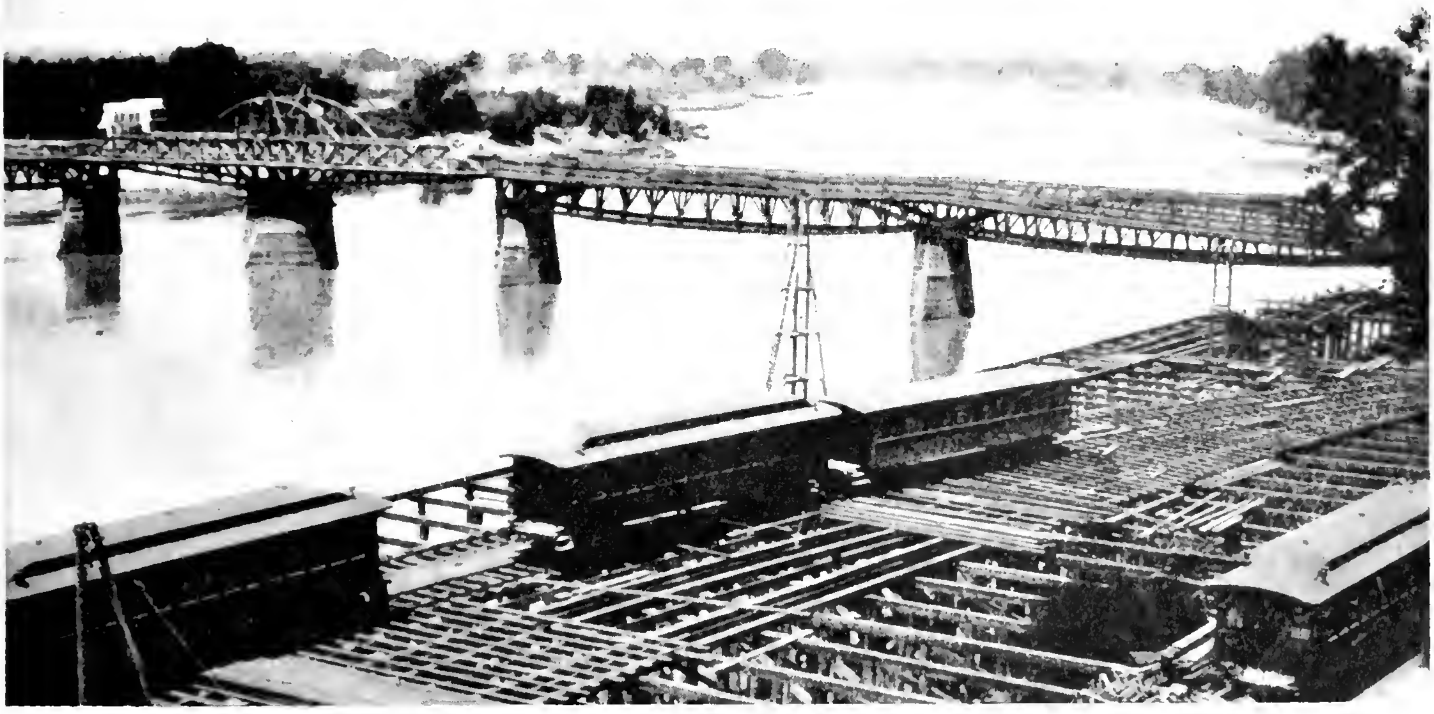
The first pile trestle attempted was the plank toll road built in 1851 on Mission Street in San Francisco. When 20 foot piles and 20-foot followers drove out of sight, log cribs were set on plank mud sills, but even these sank five feet in a few months.

The first timber trusses were king posts (1850) and queen-posts (1851) like those shown on *Plate I.* Of these, Lisle's Bridge over the American River near the present crossing of U. S. 40 (16th Street) had a continual record of partial and total failures, particularly in the years 1853, 1862, 1864 and 1868. The Sacramento *Union* reported (June 12, 1857) that it sustained a gross load of 19,580 pounds in a wagon drawn by seven yoke of oxen. Apparently it had a lift span, probably the first in California.

Famous Truss Bridge

A famous truss bridge with the first swing span in California was the "Sacramento and Yolo Bridge" over Sacra-

Sacramento-Yolo swing bridge over Sacramento River at Sacramento, built in 1858. Note curved chords of timber truss approach spans, pile driver at dock and early railroad coaches on wharf



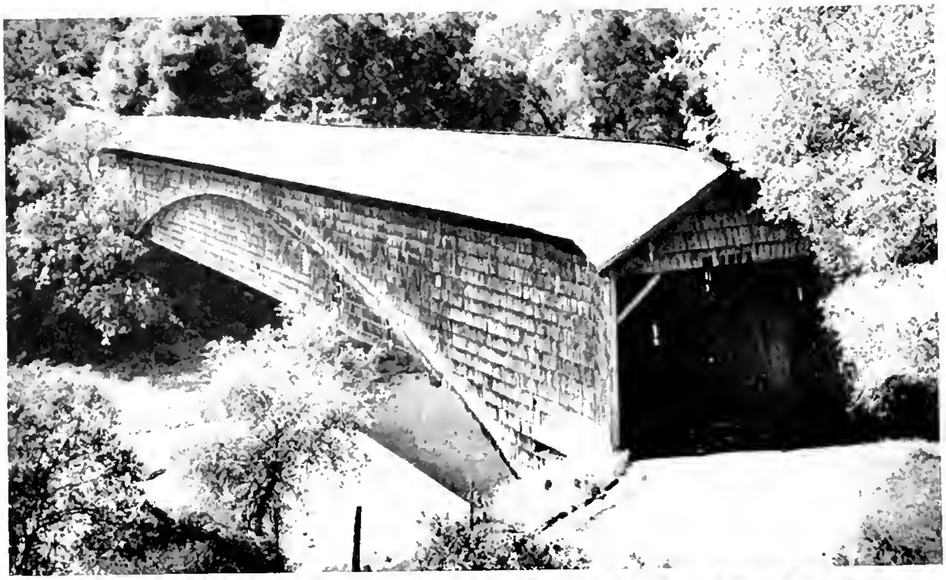
mento River, from Broad Street in Sacramento to Ann Street in Washington (See illustration). It was authorized by the Legislature in 1857, piles were driven that fall and it was completed the following June at a cost of $60,000. Piles and timber came by boat from Puget Sound. The Sacramento *Union* of June 26, 1858, describes it in some detail, particularly that the draw span was supported on 17 rollers and that one man could open it in 1.5 minutes with a 10-foot iron hand spike. Lower chords of the swing span were 75-foot timbers, "the tallest timber, probably, ever used in bridge building." During the test of the draw machinery, one man was crushed to death between fixed and swing spans. The trusses were tested by hauling several loaded drays and 151 head of cattle in a compact mass of 75 tons all the way across the bridge. It was a toll bridge competing with a toll ferry and charging from 5 cents (for commuting foot passengers) to $1.25 for a loaded three-team wagon.

Covered Bridges

For long life, timber bridges had to be well built and securely roofed. Three notable structures still stand as monuments to the craftmanship that went into covered bridges. These are:

Name	River	Spans	Built
Bridgeport	South Yuba	225	1862
O'Byrne's Ferry	Stanislaus	187	1862
Knight's Ferry	Stanislaus	4 at 136	1864

Of these many covered bridges, perhaps the most remarkable was the structure across the South Fork of the Yuba River at Bridgeport in Nevada County (*See illustration*). This bridge, which still stands, was built in 1862 by J. W. Woods, and consists of a Howe truss upon which was superimposed an auxiliary arch, and to which were added counter struts, making a composite structure somewhat similar to the design first prepared by Mr. Theodore Burr for a bridge constructed in 1804 across the



UPPER—Bridgeport Covered Bridge (timber Burr truss) over South Yuba River; longest timber truss in State; longest covered timber truss in United States. LOWER—O'Byrne's Ferry Bridge over Stanislaus River, built in 1862. CENTER—Interior of O'Byrne's Ferry, showing auxiliary arch which buckled when bridge was completed

Hudson River. The arch ribs consist of four timbers, each 5 inches x 14 inches, between which are sandwiched the two trusses. The span of 225 feet is the longest covered span in the United States. Timber was used for the chords, arch ribs, and diagonals, and iron was employed for the vertical tension members, the bearing shoes, and bolts. For many years this bridge was the property of the Virginia Turnpike Company, and tolls continued to be collected on it as late as 1880.

Relation of Arch to Truss

The relation of arch to truss is shown in the picture of the covered bridge over the Stanislaus at O'Byrne's Ferry. In this bridge the arch ribs have buckled but the trusses are intact, showing at once the difficulty of cambering a composite structure so that each system shares the load, and the expensive security of providing two supports for the same burden. It became a free county bridge in 1906 and is still in service.

The suspension bridge was an early competitor of the timber bridge, particularly for locations over deep gorges of the Mother Lode country. One advantage was that erection did not require falsework. Another was that cable wire, which at first was shipped around the Horn, was comparatively light and could be cut into units small enough for transport by pack trains. The pioneer in this field was W. B. Wilson who built a 150-foot wire bridge over the Cosumnes in 1852 to replace a timber trestle destroyed by flood.

Suspension Bridges

Other suspension bridges followed immediately, but not always with equal success. One at O'Byrne's Ferry collapsed under a load of six oxen and two men in November, 1853, after a few months' service and the rebuilt bridge was lost in the 1862 flood, so the covered bridge already described was preceded by a ferry and two suspension bridges. The Whiskey Bar suspension bridge over the North Fork of the American River lasted from 1854 to 1862. This bridge was replaced by the suspension bridge at Rattlesnake Bar (*See Plate I*), which is still standing but doomed by the construction of Folsom Dam.

There were two suspension bridge failures at Nevada City. The first, erected in 1853, had to be taken down. The second was an engineering marvel with its 320-foot span and 14-foot roadway, but it collapsed after two months' service in July, 1862, killing two men and 15 oxen. The third bridge lasted many years. Still longer was the 350-foot suspension bridge at Folsom over the American River, built in 1861 to replace a 387-foot timber bridge. It failed in the 1862 flood and was replaced in kind.

Remains today of Westmoreland's Suspension Bridge over Mokelumne River at Lancha Plana, built in 1856; timber towers standing, but most of deck has fallen

Two suspension bridges built in 1856 survived the 1862 flood and are now standing as historic landmarks. One at Lancha Plana over the Mokelumne River, following the flat-boat ferry, which named the site, and two short-lived trestles, is only a picturesque ruin today (*See illustration*). Known as Westmoreland's Bridge, it spanned 300 feet between timber towers connected with oak dowels. Most of the timber deck has been lost from old age, but the badly rusted cables and suspenders are still hanging across the river.

Bidwell Bar Bridge

Better known is the shorter (245 feet) Bidwell Bar Bridge across the Middle Fork of Feather River, now preserved in Curry-Bidwell State Park (*See photo*). Originally the cables were bright yellow, supporting a timber stiffening truss and deck, but the timber decayed and has been replaced by a steel stiffening truss and new deck. If built, the Oroville dam across the Feather River will submerge this old landmark.

Many others were of this type. There were four on the Cosumnes River, one of which (Lamb's Bridge on the Latrobe-Plymouth Road) killed one man and seven horses when it fell in 1869. At least one was moved, for Lyon's Bridge over the North Fork of American River served at Condemned or Murderer's Bar from 1856 until 1865 when the cables were dragged along the river for re-erection on the Auburn-Coloma Road. Its 258-foot span sagged 22 inches when inspected in 1925, but it served until 1930 when it was replaced by a new suspension bridge that became obsolete in 1948.

Not all were built in the Mother Lode, for Klamath River was bridged in 1861 at Martins Ferry. This was the predecessor of many suspension bridges in the primitive northwest of the State where the Pioneer Era continued long after 1875.

Bridge Building Industry

Bridge building became an industry in 1855 when the A. S. Halladie & Company of San Francisco started furnishing some materials for suspension bridges. The firm patented a design (used at Folsom in 1861 and Nevada City in 1862), and by 1864 was drawing its own wire.

Before leaving this Pioneer Era, the role of private enterprise must be mentioned again. Practically all of the structures built before the 1862 flood were privately owned toll bridges. Most of these had been so profitable that they

Bidwell Bar Suspension Bridge over Middle Fork of Feather River is the oldest still in service in California, although the timber canceled truss shown here has since been replaced with steel

were quickly replaced after destruction by the flood, and this was fortunate because public funds would not have been available for many years. In most cases the enterprise was a single bridge, as at Coloma where Little was reported in 1850 to be collecting $250 per day from a bridge which had cost $20,000. Others were toll roads with one or more bridges, sometimes as the property of a firm operating stage coaches and freight lines.

Competition Develops

Competition developed between rival bridge owners, notably between Yuba City and Marysville over the Feather River. A cheap truss erected in 1853 collapsed in 1854. A second was built while the first was being repaired and the two competed until 1859, when the second one withdrew. An act of the Legislature that year authorized the county to build a competing toll bridge, which it did in 1861. The private bridge was made free temporarily in an attempt to ruin the business of the county toll bridge, but the competition ended in December, 1861, when the private bridge washed away in a flood. The county bridge became free in 1871, its cost having been liquidated in 10 years.

The first notable free bridges were built in 1862 at Nevada City (Deer Creek) and West Point (Mokelumne River). Dissatisfaction with jerry-built structures, monopolistic tolls and unreasonable profits induced a trend toward public enterprise that was nearly universal at the end of the Pioneer Era. As an example, Sonoma County had 629 bridges by 1877, and almost all important crossings on the main wagon roads had free bridges of some kind.

The Railroad Era

With the completion of main line tracks connecting with coast ports and inland waterways in 1876, railroads began to control many features of California's economic and political development. Location of their lines was followed by growth of communities and, as a corollary, towns could not prosper without rail connections. They had become great bridge builders; now they transported foreign bridge materials to new locations. Iron from the east, and later steel, was available in the State and throughout the State.

The first railroad bridges were cheaply built because railroad builders were racing to extend their lines as far and fast as possible. Later these early bridges were reinforced and replaced with more durable structures to carry heavier locomotives at higher speeds.

Small bridges were built in great numbers on the feeder wagon roads leading to railheads. Roads parallel to the railroads developed more slowly because long wagon hauls could not compete with shipments by rail. The reclamation of valley lands by irrigation called for many small bridges, because the canals carried water for much longer periods than the ephemeral streams which were characteristic of the region.

Iron and Steel Bridges

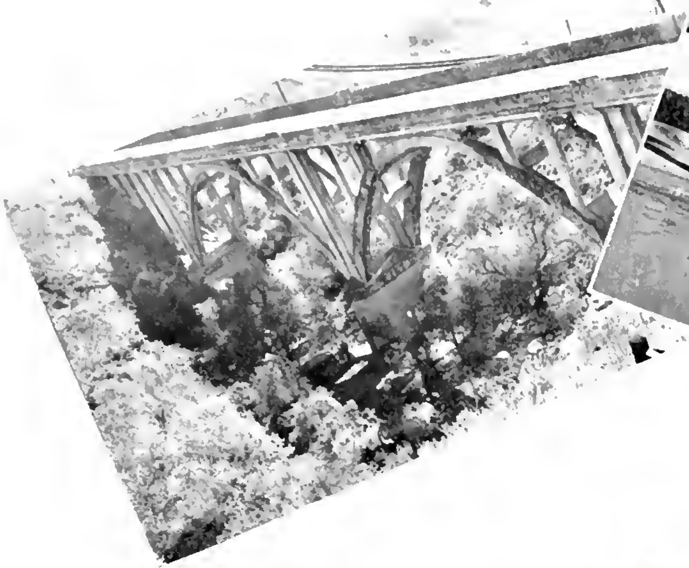
Types of bridges built in the Railroad Era followed more closely the development of the art in other regions. Railroads favored iron and steel for large bridges and timber trestles of standard design for small or low bridges. Road bridges showed preferences of local authorities—timber in one county, stone masonry in the next. Trusses used steel instead of timber, first in tension members and later in all members. Larger and larger concrete structures were being designed at the end of the era. *Plate II* illustrates the trend for the larger highway bridges.

One of the more dramatic sequences of bridges occurred on the Colorado River below Needles. The 35th parallel transcontinental railroad was completed August 13, 1883, when Southern Pacific bridged the river to connect with the Atlantic and Pacific railroad on the Arizona shore. This hastily-built pile trestle was destroyed by flood on May 4, 1884, and replaced by A. & P. with a long series of 80-foot strain-beam trusses on pile foundations. Six years later in the flood of May 9, 1890, this second bridge was destroyed, but its loss had been anticipated and Santa Fe's famous Red Rock Cantilever Bridge was practically ready at Topock, nine miles downstream. Its 660-foot main span made it the longest cantilever in the Americas, but heavier locomotives forced the railroad to build a central pier in 1911 to cut the main span in two.

Recently Santa Fe built a new bridge nearby and gave the Red Rock Bridge to the States of Arizona and California for a highway bridge on U. S. 66, and the states in turn sold its Old Trails Arch Bridge to the Pacific Gas and Electric Company for its interstate gas transmission line. An illustration shows the three Topock bridges (page 124).

First Steel Movable Bridge

The first steel movable bridge was the swing bridge built by Southern Pacific across the estuary from Oakland to Alameda at Webster Street in 1881. Originally it was swung by hand, but power mechanism was added later. Heavy locomotives made it obsolete, so it became a highway bridge and in 1898 was moved to its present site over San Leandro Bay connecting Alameda and Bay Farm Island. In spite of two partial collapses, it is still in service but will be dismantled as soon as a new structure can be built. Its 209-foot swing truss was notable in its day, it being one of the first to use steel instead of wrought iron.



UPPER LEFT — Cast-in-place reinforced-concrete open-spandrel arches (2 @ 109 ft.) over Arroyo Quemada; built in 1917. UPPER RIGHT—Precast (Thomas) reinforced-concrete open-spandrel arches (4 @ 146 ft.) over Yuba River at Parks Bar; built in 1913

Steel-and-timber combination trusses (200-ft. main span) over Santa Ynez River east of Lompoc; built in 1900

LOWER LEFT—Trussed (canticrete) concrete closed-spandrel arches (7 @ 60 ft.) over Pajaro River at Watsonville; built in 1915. LOWER RIGHT—Steel Pratt trusses (5 @ 140 ft.) over San Benito River at Hollister; built in 1912

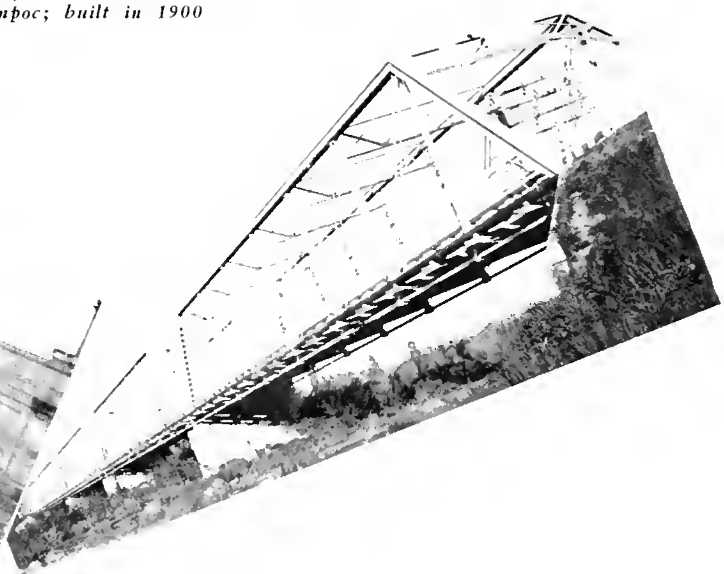


PLATE II
Typical Bridges Built in 1900-1917

Albion River Bridge, built in 1922 and replaced recently, was a three-span timber six-panel Howe truss supporting a trestled deck, but extra bracing has reduced trusses to four panels

Practically all of the steel bridges built in this era on wagon roads and county highways were designed by or for engineering and contracting firms on a competitive basis. Name plates decorating end posts can still be found to prove the activities of the following: American Bridge Company, Berlin Iron Bridge Company, Canton Bridge Company, Clinton Bridge Company, Kansas City Bridge Company, Milwaukee Bridge and Iron Company, Phoenix Bridge Company, Phoenix Iron Company, San Francisco Bridge Company, Toledo Bridge Company, Western Bridge Construction Company, and Youngstown Bridge Company.

Types of Bridges

Specifications for these bridges varied with the competition. If a lump sum price was the basis of comparison, the structure would be very light in weight, particularly as to the bracing, and such bridges today are still known as howlers, rattlers or squealers. On the other hand, if the basis was the price per ton, bridges were much more substantial; if skimped at all, it would be in the connections.

Designs followed the standards of the bridge companies with little variation. Short spans up to 60 feet were usually pony trusses. Longer spans were through trusses, narrow and low at portal clearance compared to modern standards. Design loads were so low that those still in service have been strengthened or posted for restriction of weight or speed. Alignment standards for the approaches were set for team traffic, which could easily negotiate curves of 100-foot radius.

The Hollister Bridge (*Plate II*) over San Benito River is a typical example. Built in 1912 with five 140-foot steel Pratt trusses, the impaired vertical clearance and narrow roadway are responsible for one serious collision a year, on the average. Many truss members have been straightened or replaced.

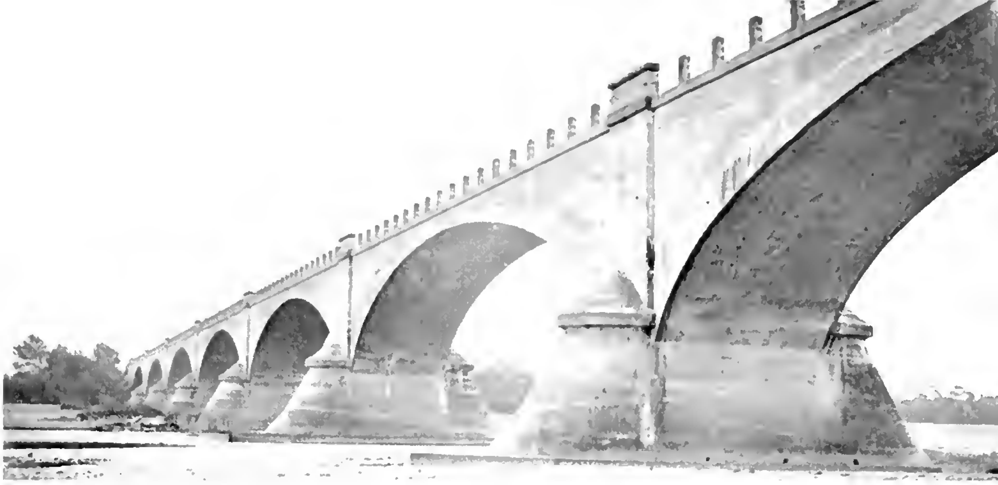
Stone Masonry Structures

Stone masonry arch bridges were economical for short spans where foundation was good and field stone at hand. Labor for gathering stone was cheap and stone masonry was an ordinary skill. The results were solid and substantial so that many are still in service carrying modern loads without restriction. Napa County made particularly good use of the stone arch, as witness the picture of the Putah Creek Bridge of three 70-foot spans on Sign Route 28 near Monticello, built of cut native sandstone in 1896. Its only threat is the proposal to build Monticello Dam, which would inundate the bridge to a depth of 150 feet.

Portland cement concrete, which had been used for mortar in foundations, took

Monticello Bridge over Putah Creek, built in 1896, has three 70-foot arch spans of local sandstone. It would be inundated if Monticello Dam is built

the place of stone masonry in regions devoid of good building stone. At first the use was restricted to plain concrete arches, beginning about 1895. Lengths were gradually increased as reinforcement was added and confidence was gained in design. Small slab and T-beam bridges were being built in 1905, notably the Alford Lake Bridge in Golden Gate Park with its 20-foot soffit decorated with artificial stalactites.



Fern Bridge over Eel River, with its seven 200-foot filled-spandrel concrete arches, was the longest of its type in the west when built in 1911

Monumental Structure

Leonard's bridge over Eel River at Singley's Bend (now Fernbridge) was (and still is) a monumental structure that gave a tremendous impetus to the use of reinforced concrete. Built in 1911, its seven 200-foot filled spandrel arch spans (*See illustration*) are still the longest of that type in the State. Thrusts are balanced over deep pile foundations in a shifting sandy bed subject to deep scour. Its heavy cut-waters have withstood ramming by the heaviest drift logs found anywhere. Except for width of roadway and profile of approaches, which were generous in 1911, the bridge is fully adequate today.

No doubt this bridge was the precedent needed for construction of Pasadena's Colorado Street Bridge over the Arroyo Seco in 1913 and San Diego's Cabrillo Bridge in 1914, both of which are show places in proud communities. The Cabrillo Freeway on U. S. 395 passes under the Cabrillo Bridge. The proposed Colorado Street Freeway will cross on a new arch bridge beside the old, using it as a connecting link for local traffic.

Concrete Design

Concrete design became a specialty for a few engineers, two of whom patented outstanding types. One was the Thomas Arch by William M. Thomas, who conceived the idea of precasting arch ribs and spandrel columns on the ground and hoisting them into position. *Plate II* shows a fine example of four 146-foot spans erected over Yuba River at Parks Bar in 1913. The site is of interest because mining debris raised the bed of the river 81 feet (elevation 146 to 227) in the 52 years, 1848-1900, and gradual restoration by natural processes of erosion has lowered the bed 24 feet, exposing the foundations under the piers and revealing foundations of an earlier bridge which had been destroyed by the flood of gravel.

Atascadero Underpass, one of the oldest grade separations; the narrow crooked highway, passing under a bridge built by Southern Pacific in 1902, is protected from flooding by a concrete wall

The other was the Canticrete patent of Leonard & Day, for which a steel cantilever truss was erected over the piers to support formwork and reinforce the concrete which was cast around it in a shape resembling an arch. A typical example is the Main Street Bridge over Pajaro River at Watsonville (*Plate II*) built in 1915. Although the superstructure was in good condition after 35 years service, it is being replaced with a wider deck at higher clearance over the river.

The Railroad Era ended with the completion of the last long-haul lines—the Western Pacific, the San Diego and Arizona and the Northwestern Pacific in 1915. It included a brief development of electric interurbans, such as Pacific Electric and Sacramento Northern. The outstanding bridge novelty of this late railroad building was Northern Electric's pontoon bridge over Sacramento River at Hamilton City, built in 1908, but this may not have been real progress.

The Highway Era

For highways, the passage of the $18,000,000 bonds for a state system in 1910 marked the beginning of a new era. At first, bridge construction had been

Red Rock Bridge (center) over Colorado River near Needles, once the longest cantilever in America, became a 4-span continuous bridge with addition of central pier. When Santa Fe Railroad shifted to new bridge (left), U. S. 66 was relocated via Red Rock Bridge, leaving the Old Trails Arch (right) for the Texas-California gas transmission line

left to the counties so that many short sections of highway were excluded until old bridges were replaced or new ones built. A change in policy started in 1915 when the State began to participate in the cost of major bridges.

Other factors contributed, of course. The automobile became an economic competitor of the horse in 1915 when Fords were sold for less than $500 and gasoline for less than 10 cents per gallon. The expositions that year in San Francisco and San Diego attracted more than a million people, many of whom stayed here, increasing the demand for land. Panama Canal was completed, reducing freight rates on eastern steel and cement.

The Highway Era was (and still is) characterized by a progressive raising of standards of design for high speed, heavier loads, multiple lane, long life and safety. For example, at the beginning of the era, it was considered good economic practice to select bridge sites at narrows of streams where the structure would be shorter and foundations better, because bridges cost 10 times as much as paved approaches. Gradually the practice has changed, first to avoid dangerous curves at bridge heads and later to shorten highway distances, until now the bridge is built where highway alignment happens to intersect a stream line. This trend was not caused by a change of relative cost of bridge and pavement, but by an increasing value to traffic of shorter distances, straight alignment and safe operation. As a result the skew bridge is now the rule instead of a rare exception, and this rule has had a great influence on the development of certain types of structures, such as the box girder and the single-column bent.

High Loads on Through Bridges

As another important example, long bridges of the Pioneer and Railroad Eras were through bridges which have lateral and portal bracing over the deck. Often this bracing was so low that high loads were prevented from using the bridge. In the case of slow-moving wagons the insufficient clearance would be evident before damage was done, but high loads on trucks frequently collided with and damaged the bracing. Similarly wide overhanging loads collided with web members of the truss. *Plate IV* illustrates the modern trend toward deck bridges which do not impair overhead or lateral clearances.

During the era, public enterprise in road and bridge construction, which had largely supplanted private enterprise, tended toward higher levels of government. The State began to build the long-haul roads, the primary system connecting county seats and heavy-construction routes into undeveloped regions. This interest was extended to feeder roads and laterals in the counties and to selected arteries in the cities. Federal Aid was extended to the states and through the states to counties and cities, first because of nontaxpaying public lands and later because of interstate routes and hazard at grade crossings. This trend generated higher standards and more uniformity in design of bridges.

Long Span Structures

The era was started with state participation in four unprecedented bridges. The Old Trails Arch over Colorado River (*see illustration*) was a slender three-hinged steel arch spanning 592 feet, the longest of its kind at the time. California, Arizona and the United States each contributed one-third of its cost. The Yolo Causeway, 3.13 miles long, boasted of the longest (14,106 feet) highway concrete trestle in the world, and was the first major bridge designed and built by the State. The Pit River Bridge, now submerged in Shasta Lake, was built jointly by State and county; its 242-foot concrete arch was the longest concrete span for many years. The South Scotia Bridge over Eel River with its two 302-foot trusses was also a State-county project. All four were completed in 1916.

Back Log of Projects

The slackening of construction on the West Coast during World War I created a back log of projects for the succeeding years. Checking of county plans for bridges on the State Highway System became so important that a Bridge Department was created July 1, 1919. The grade separation program which started in 1921 added a new field for design. In 1924 the department was expanded to take charge of bridge construction as well

as design and the counties were practically relieved of their former obligation to provide bridges on state highways. Bridge building was a $1,000,000 business which grew to $2,000,000 in 1930, $4,000,000 in 1940 and $18,000,000 in 1950.

Improvement of timber bridges is remarkable in some ways. Even the simple log bridge grew to 85-foot spans over Trinity River (*see photo*). Timber trestles were standardized and used by the hundreds on desert routes, facilitating the rapid expansion of such routes and spreading the cost of maintenance and ultimate replacement by permanent types over a long period. Multistory timber trestles made good use of local materials in the Northwest. At Albion River in 1922, timber Howe trusses were set high on multistory bents (*see photo*) in spectacular and somewhat precarious fashion. During World War II, timber was used as an emergency material when steel was in short supply, but in a surprising upset at the end of the war the demand of housing for timber made it too expensive for bridges.

Suspension bridge of 360-foot span built in 1940 across Klamath River at Orleans. Awarded American Institute of Steel Construction Prize as most beautiful of its class

Short Timber Trusses

Los Angeles and Orange Counties used hundreds of short timber trusses of a characteristic type, singly or in series on trestle bents. Several of the Santa Ana River bridges are of this type and although mortality was high in the 1938 flood, the bridge at Atwood with 25 spans of 40-foot A-frames is still in service. Others had Howe pony trusses up to 54-foot spans.

Timber bridges have also proved more vulnerable to fire with the coming of motor vehicles. Twenty bridges have been totally destroyed by fire in the last decade, mostly after collisions in which the vehicle burned first. Originally water barrels were maintained on all timber bridges, but the cost of keeping them full of water exceeded the cost of replacing an occasional victim. The risk is another reason for the passing of the timber bridge.

Steel Warren deck trusses (3 @ 265 feet) over San Luis Rey River at Oceanside on XI-SD-2-C; built in 1929

Carquinez Bridge

Steel bridges, on the other hand, have advanced with the times. The trend to deck types has already been mentioned. Another conspicuous example is the Oceanside Bridge over San Luis Rey River (*see photo*) built in 1929 on a high grade so as to provide waterway clearance under the deep Warren trusses of 265-foot span. It is the fourth bridge at the site, having been preceded by low pile trestles before and after the Thomas Arch bridge which was destroyed by the 1916 flood. It will soon be widened or replaced as a part of the Oceanside Freeway.

The Carquinez Bridge completed in 1927 by the American Toll Bridge Company and purchased by the State in 1940 is noteworthy for its two 1,100-foot cantilever spans high above Carquinez Strait (*see photo*). It was the most ambitious bridge undertaking of private enterprise. It liquidated its cost and became a free bridge in 1945. Other private toll bridges of this late period were the Antioch Bridge over San Joaquin River and the Ehrenberg Bridge over Colorado River (both of steel and free now) and the San Mateo-Hayward and Dumbarton Bridges over San Francisco Bay (still privately operated).

The Southern Pacific crossed the same water gap at low grade over its Martinez-Benicia Bridge in 1930, replacing a car ferry. This structure is 5,603 feet long, including seven 526-foot steel trusses

Carquinez Bridge, a cantilever with two 1,100-foot main spans, was built in 1923-27 by the American Toll Bridge Company. Traffic has reached 33,993 vehicles in 16 hours

(the longest in the State) and a 328-foot vertical lift span.

Cantilever Bridges

Cantilever bridges are usually ungainly structures because of the arrangement and proportions of members carrying negative moment over the towers and into the anchor span. Line and proportion can be greatly enhanced by making the cantilever a deck structure, as will be evident in the illustration of the Noyo River Bridge near Fort Bragg.

The plate girder, so widely used by railroads in deck and half-through bridges of single or multiple span, is still a popular type. Multiple girders are usually made continuous, or are hinged in the spans with some cantilever action. Longest plate-girder span is 200 feet in the Figueroa Overhead in Los Angeles. *Plate IV* shows a recent four-span continuous design for Nojoqui Creek.

Steel continues to be the best material for movable bridges because of the high ratio of its strength to its weight. Other materials with higher ratios are much more expensive. There are nearly 100 such bridges over navigable waters in the State, of which several have been mentioned already. The I Street Bridge carrying railroad and highway on separate decks over Sacramento River is noteworthy for the 390-foot swing span. The longest double bascule bridges are the six over Sacramento River and Steamboat Slough between Freeport and Rio Vista, each spanning 226 feet. Petaluma has a single-leaf bascule spanning 148 feet. Handsome is the Tower Bridge over the Sacramento River, like a gateway to the Capitol Mall; it won honorable mention in the prize awards for 1935. The new Mossdale Bridge over San Joaquin River *(Plate IV)* has an unusual counterweight for its bascule span; built with heavy magnetite aggregate to reduce its bulk, its shape conforms to the curve of the trunnion and the Warren frame of the leaf.

Suspension Bridges

Suspension bridges, of course, have been built to monumental proportions. The San Francisco-Oakland Bay Bridge, completed by the State in 1936, has so many noteworthy points that it will be covered in a separate article. To name a few, it established new depths for caisson foundations (240 feet below MLLW), uses a massive center anchorage to balance differences in its two serial suspension bridges, is a continuous bridge through a tunnel, has as a part of the East Bay Crossing the longest (1,400 feet) cantilever in the United States, set a record for cost ($77,000,000), and has carried 95,000 vehicles in one day. Financed by revenue bonds, its cost will be liquidated in 1952 by tolls which are now less than 5 cents per mile of structure. The Golden Gate Bridge, completed a year later at half the cost, boasts a 4,200-foot span, the longest in the world. It was also financed by revenue bonds, in this case sponsored by local governments organized as a bridge and highway district.

Short suspension bridges are still economical in primitive areas. An out-

Steel deck cantilever (405-foot span) over Noyo River near Fort Bragg; built in 1948

standing example of modern design is the prize-winning Orleans Bridge over the Klamath River (*see photo*) spanning only 360 feet. The elliptical portals under the saddle towers combine beauty with strength and high clearance.

Concrete Bridges

Concrete bridges have been left to the last because of the many new applications of this material in the Highway Era. At the beginning, concrete was used only in very small structures or in arches, the latter designed to make optimum use of concrete in compression. Design has continued to use only the compressive value of concrete, but ingenuity has developed frames other than the arch which minimize tensile stresses, and deck sections which use only a small amount of concrete around steel members in tension. A few of the devices are the T-beam, the rigid frame, the continuous girder, the short end cantilever and prestressing. Other important factors were the control of concrete materials to assure specified strengths, the use of light-weight aggregates, air entrainment and admixtures, advances in cement technology, research into interaction of concrete and steel, availability of local cements and development of new techniques in stress computation.

Of the concrete arches, the first large project of the State was the Douglas Memorial Bridge over the Klamath River, with five 210-foot spans completed in 1926. In 1932 the record-breaking 330-foot Bixby Creek Arch, said to be the highest concrete arch in the world, was built on the Monterey Coast Road. One of the handsomest (*Plate IV*) is the 240-foot arch over Russian Gulch, in which the open spandrels are varied in length, the highest spandrel columns being the farthest apart. Others are shown and described in *Plate III*.

Concrete Girder Bridges

Concrete girder bridges developed to large proportions early in the period, spans of 20 to 60 feet being quite common. In fact the longest spans of this type were built in 1919 when Salt River was bridged at Port Kenyon by two half-through 142-foot spans supported by two I-shaped concrete girders 12 feet deep. In the shorter examples, the girders act with the slab like parallel T-beams. When clearance is limited, girder soffits are raised and widened. The limit of this modification is the slab bridge, which simplifies formwork, is economical for spans up to 40 feet and has been used for a 64-foot span in Fresno (California Avenue).

Economy of either girder or slab is increased by providing negative moment over the supports so as to reduce positive moment at midspan. Continuous girders are widely used in this way. For single spans and end spans of multiples, the provision is made by adding a short end cantilever or fixing the span to the abutment wall, the latter forming rigid frames. In one instance, the Santa Paula Creek Bridge on Route 126, the main span of 120 feet is balanced by 17-foot end cantilevers held down by counterweights, producing a slender slab-girder design to fit a difficult combination of low highway grade and high flood plane.

Box Girder Bridges

The modern development is the box girder, in which the tension steel is not closely confined in the bottoms of girders but spread in a lower slab, and shear is carried in vertical web walls like parti-

Reinforced concrete curved box-girder spans (6 @ 81½ feet) on cylindrical single-column bents over Alameda Creek on IV-Ala-107-A; built in 1947

tions, enclosing cellular spaces between the two slabs. The type is particularly adaptable to curved alignment, so that it is widely used in freeway structures. Its adaptability is shown in the picture of the recent (1947) bridge over Alameda Creek and the Western Pacific Railroad. Ten years ago such an oblique crossing would have been designed with skewed piers and diamond-shaped spans, but the single-column bents and box girders were easily fitted to the geometric pattern with little obstruction to the channel. The longest box girder span built so far is the 136-foot span just completed on Hollywood Parkway over Figueroa Street, but another under construction at Heliotrope will have a 143-foot span so that the economic limit of this type has not been reached yet.

Serious consideration is being given to precasting and prestressing of concrete slabs and girders. Precasting has been tried experimentally and prestressing is having its first trial now. This technique is being used on a bridge over Arroyo Seco in Los Angeles, the first such experiment in the West.

Situation Today

With all this bridge construction in the past century, producing perhaps 50,000 bridges of which 30,000 are standing, there is still a great demand for more bridges. The State's program foresees expenditure of over $100,000,000 in the next four years. The Bay region is asking for several more great bridges, each of which would cost more than this amount. There are still fords and ferries on the state system, besides the many dips over dry washes that occasionally interrupt traffic. As traffic increases there will be demands for many new bridges for such crossings.

Recalling that bridges in service on major highways have been built over a period of 70 years, it will be obvious that there is a wide variation of load capacity. Many old ones have been strengthened, but many are still posted for restricted loads or speeds. New ones are built for a safe margin over a standard of strength. Nevertheless, and this would be true for

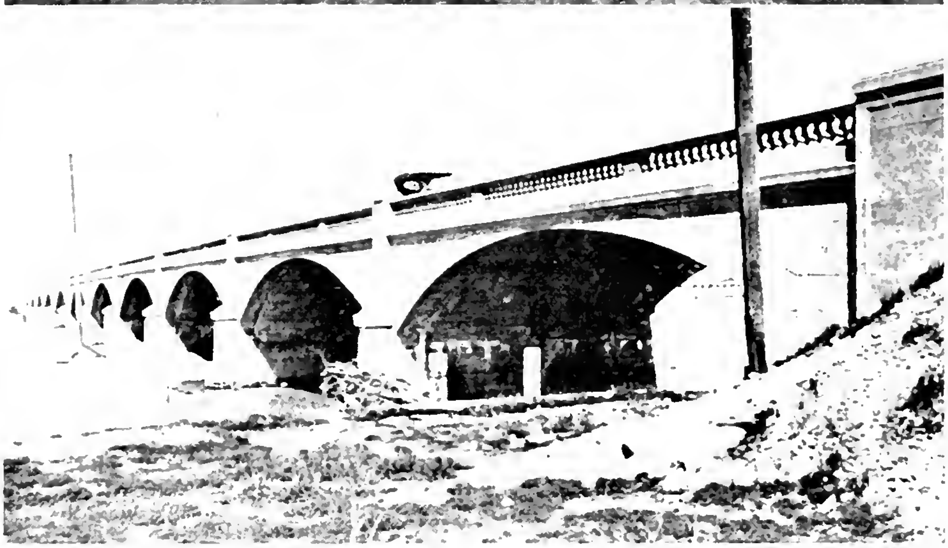


PLATE III

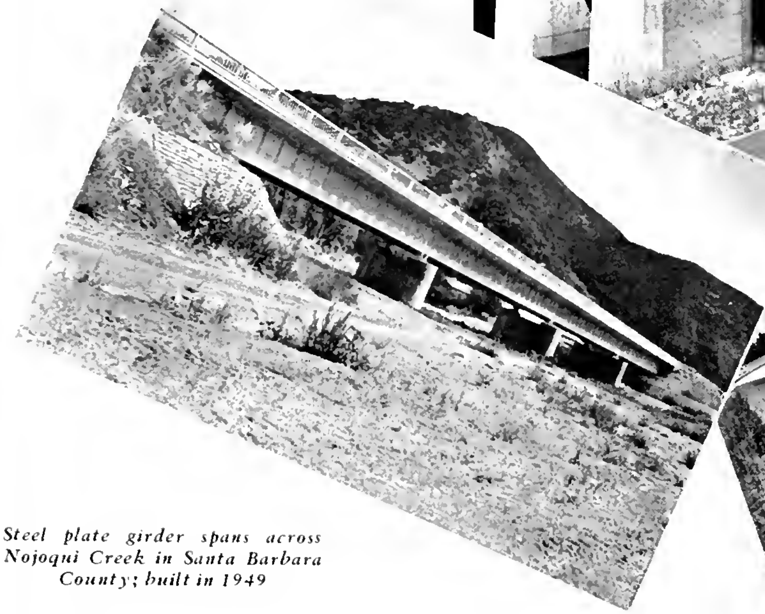
Early Concrete Bridges

UPPER—Pit River Arch was longest concrete span (242 feet) in California when built in 1916; it is now submerged deep in Shasta Lake. CENTER—Stony Creek Bridge is 1,187 feet long and consists of 13 filled-spandrel arches. LOWER—Atascadero Creek Bridge, an 80-foot concrete arch built by San Luis Obispo County

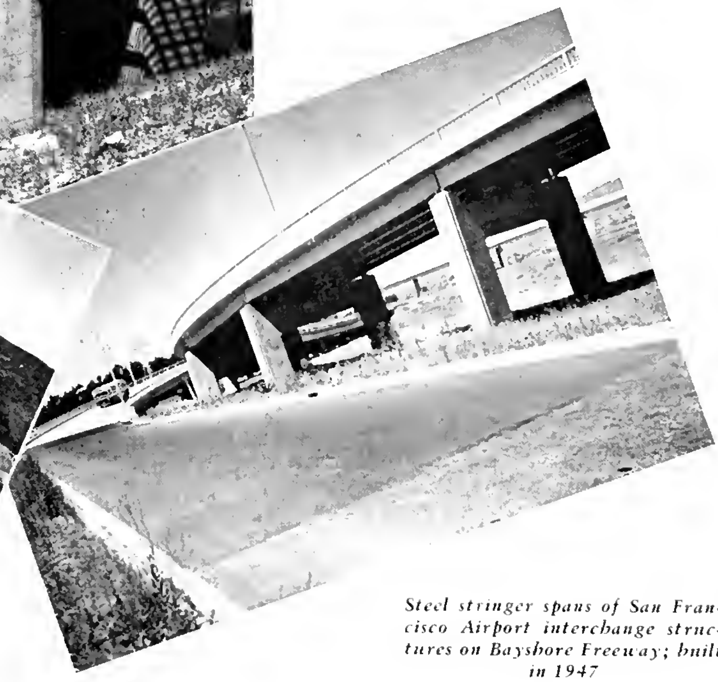
Parabolic soffit steel plate girder spans across South Fork of Eel River at Smith's Point; built in 1934

Open varied spandrel concrete arch across Russian Gulch in Mendocino County; built in 1940

CENTER—Hidden machinery and graceful magnetite concrete counterweight feature this bascule trunnion assembly, San Joaquin River at Mossdale; built in 1949



Steel plate girder spans across Nojoqui Creek in Santa Barbara County; built in 1949



Steel stringer spans of San Francisco Airport interchange structures on Bayshore Freeway; built in 1947

PLATE IV
Modern Bridges

any standard of strength, there is occasional demand for special permission to haul unusually heavy loads over bridges. Carrying the 200-inch mirror from Pasadena to the observatory on Palomar Mountain was one instance. Lesser requests are received nearly every day, so that we can foresee that standards of strength may have to be raised still higher than they are today.

Contrasting new bridges with the old, this report has exemplified bridges over streams, neglecting grade separations. These latter started humbly without publicity when wagon roads were located through railroad culverts. Railroad grade separations were built especially for the purpose in 1917 and highway separations as early as 1911 (Mission Street in San Francisco). Today such bridges are "big business," largely because of freeways, so that 72 percent of our current budget is for grade-separation structures.

Summarizing a century of progress in California bridges, we could say that the number has increased from two to 30,000; load capacity from ox-cart to diesel trucks, locomotives and military tanks; span from 20 feet to 4,200; and width from 10 feet to 100. But the important progress has been in the development by public enterprise of free bridges wherever bridges are needed. When man wants to cross, no river's too wide or deep, no price too high or steep.

View of San Francisco-Oakland Bay Bridge looking westerly across the structure showing the City of San Francisco in the background

Chapter XVI

Highway Progress Since 1943

By Richard H. Wilson, *Assistant State Highway Engineer*

There are approximately 14,000 miles of state highways in California serving an estimated 10,875,000 people and 4,580,000 motor vehicles. The economic and social welfare of the State and the defense of the Nation are particularly dependent upon these traffic arteries. It is the function of the Division of Highways to construct and maintain the State Highway System to the highest degree possible with available funds.

In 1943 the Nation was embroiled in World War II. All normal peacetime activities had been set aside for the necessity of all-out war effort. Concurrently with this transition in national life, the activities of the California Division of Highways had undergone drastic and rapid changes.

For many years prior to the war, improvement to the California State Highway System had been on a definite program of development aimed at providing adequate facilities for motor vehicle transportation of the entire State and highway budgets had been prepared on that basis.

War Program

Beginning in 1941, as the possibility of the United States entering the war became more and more imminent and the national defense program rolled into action, construction costs began to rise rapidly. Shortage of rubber, speed limitations and rationing of gasoline resulted in material reduction of state highway revenues. Budgetary set-ups based upon prewar estimates became obsolete and their continual revision became the order of the day.

Working in conjunction with the Public Roads Administration the Army, Navy, and Marine Corps, the Division of Highways had prepared a comprehensive program of projects for construction of roads serving as access to military and naval establishments in California and to industrial plants engaged in production of material and equipment needed for prosecution of the war. Of the $290,000,000 appropriated by Congress for such access road construction throughout the Nation, California was originally allotted approximately $35,200,000. With its depleted engineering personnel the Division of Highways prepared plans for and supervised construction of 209 contracts costing $38,443,000.

Highway Work Curtailed

During the war period federal restrictions on materials and equipment further curtailed highway activities to the extent that construction was practically at a standstill. Maintenance operations were limited to the barest essentials. Repair of highway surfaces and bridges, however, became the major activity of the department in an effort to stem to some degree the accelerating deterioration of the State Highway System.

With highway construction and development being blocked by the necessities of the war effort the department set about with such personnel as was available to make surveys and prepare plans and specifications for the work so deferred. Under this procedure a shelf of needed construction projects was built up for the time when such operations could be undertaken at the close of the war.

There was complete agreement between the state administration and the Department of Public Works as to the relation of highways to the economic condition of California.

Importance of Highways

This agreement of opinion included the premise that all direct contribution to the conduct and advancement of the war had not been concentrated in the armed forces and war industries. Transportation was just as important a factor as fighting men, planes and tanks, for without adequate facilities for transport, these instruments of war would have been ineffective in promotion of the national effort. As a corollary to the premise is the self-evident fact that one of the most vital roles in the transportation industry is played by highways, roads, streets and bridges.

Of more importance to the period since the war and to the future was the conviction that the conduct of all operations of the Nation's business, whether in war or peace, is dependent to a large degree upon these same highways, streets and bridges. Particularly in California with its dense motor vehicle traffic and great distances does this dependency upon highways obtain. As a matter of fact, the entire economics of the State is interlaced with the need for adequate highway facilities.

Postwar Planning

At the convening of the 1943 Session of the State Legislature the tide of the war had turned and serious thought was being turned toward the postwar era and to the speeding up of preparations for that period. Recognizing the need for a ready-to-go postwar highway program that session of the Legislature, at the instance of Governor Warren, appropriated the sum of $12,000,000 for surveys, plans, specifications, and the acquisition of right of way for the postwar highway construction program.

At the same session of the Legislature the statutes governing the organization of the State Highway Commission were revised to provide for a commission composed of six members appointed by the Governor for staggered four-year terms

with the Director of Public Works serving as ex officio seventh member and chairman. Formerly commissions were composed of five members appointed by and serving at the pleasure of the Governor.

Highway Commission Terms

Under provisions of the new statute the terms of office of the six appointive members expire on January 15th, one in each even-numbered year and two in each odd-numbered year. Under this method there is a certain continuity of policy through possible changes of state administration which should prevent any abrupt shift in policy which might disrupt the long range planning of state highway development. After this law became effective the new commission took office on September 14, 1943.

With the additional $12,000,000 furnished by the 1943 Legislature, work within the Division of Highways was concentrated more and more upon preparation of the postwar construction program.

This is the old Altamont Pass on U. S. 50 before it was modernized with gas tax funds

Postwar Program

On November 18, 1943, the new commission began its consideration of projects proposed by the department for inclusion in the postwar program and on January 20, 1944, such a program was officially adopted and funds budgeted for the preliminary engineering and right of way acquisition for the projects.

The original program included 145 road and bridge construction projects, the estimated construction cost of which amounted to $80,000,000. It provided for improvement to approximately 600 miles of state highways. A very considerable portion of the program involved urban development with a large number of major structures, there being 181 bridges and 147 grade separations. Of these latter, 25 were railroad grade separations and 122 separated the grades of two or more highways.

Determination of the size of the program was based upon an analysis of available state highway funds, including the $12,000,000 legislative appropriation and all available funds from the then current and previous highway budgets. This analysis indicated that the estimated state highway revenue of four fiscal years would finance a three-year construction program amounting to the $80,000,000 figure. On this basis the projected postwar program was kept within the limits of state highway revenue in sight.

Altamont Pass as it looks today. This entire route in Alameda County is being converted to a four-lane divided highway

Selection of Projects

Selection of projects for the postwar program was influenced by several factors: First, projects where improvements adequate for existing traffic were most urgent; second, priority of projects deferred from previous budgets because of the war; third, correction of critical deficiencies in the physical status of the State Highway System; fourth, projects located in and adjacent to large centers of population where possible postwar unemployment was likely to be most severe; and finally to balance statutory requirements relative to distribution of funds between northern and southern county groups and between primary and secondary state highway routes.

In addition to the $12,000,000 appropriation for preliminary engineering and right of way on state highways, the 1943 Session of the Legislature also appropriated the sum of $1,500,000 for surveys

and preparation of plans for postwar improvement to county roads.

Federal Aid Highway Act

As the war progressed through 1944 the Nation gave more and more thought to preparation for the postwar era. On December 20, 1944, Congress passed the Federal Aid Highway Act of 1944 and California was assured of approximately \$67,000,000 in federal funds for the first three postwar years. Of this amount about \$27,100,000 was made available for improvements on the Federal Aid Primary System, \$15,500,000 for the Federal Aid Secondary Highway System, and \$24,400,000 for construction of federal aid urban highways.

The addition of these federal funds and the jump in state revenue which followed the lifting of tire and gasoline rationing called for a revision of the postwar highway program. On September 24, 1945, the California State Highway Commission adopted a construction budget of projects for the first postwar year. On April 18, 1946, and November 21, 1946, similar programs were approved by the commission for the second and third postwar years respectively.

First Three Years

The total value of these programs set up for postwar state highway rehabilitation and improvement amounted to \$145,000,000. With available funds it was possible to finance projects amounting to only \$95,000,000 for the three years. There still remained, however, in the approved programs badly needed projects amounting to \$50,000,000 which were not financed and would have to wait their turn in the future unless additional revenue was provided.

Preparation of state highway projects prior to the postwar period had so progressed during 1944 and 1945 that as soon as federal approval was received for the first year's program in October, 1945, the Division of Highways began advertising for bids and the first bids for postwar construction were opened on November 28, 1945.

This policy adopted at the close of the war of immediately placing under way a large postwar construction program was of definite advantage to the State and the motorist. It provided a degree of early relief to the rising postwar traffic and accomplished a large volume of construction at the lower prices prevailing before the inflation had really taken hold.

There were some difficulties, however, in advancing those projects on proposed freeways in the metropolitan areas of Los Angeles and San Francisco.

Protection of Tenants

During the three years before the end of the war the department had been acquiring right of way for the postwar development. Much of this right of way was covered with buildings of various descriptions—single dwellings, apartment houses, and commercial establishments. As this property was acquired it was rented in most instances to the occupants and the State became a landlord with extensive holdings in densely populated areas. In the meantime the housing shortage became more acute month by month so that when postwar construction could be started the Division of Highways was faced with the problem of either evicting tenants, at a time when it was almost impossible for them to find other quarters, or of deferring portions of needed highway development.

In conformance with instructions of Governor Warren the latter policy was pursued and no tenants were moved out until other suitable accommodations were found. This rehousing of tenants was not an easy task and it required a very considerable portion of the time of right of way agents in the territories affected.

Federal Aid Secondary Highways

In addition to the state highway programs, the Division of Highways has administered both federal and state funds for improvement to the Federal Aid Secondary Highway System. This secondary system consisted of both state highways and county roads established as logical feeder roads to the regular Federal Aid System.

For this phase of highway work, California was apportioned approximately \$5,000,000 a year for each of the first three postwar years. As it was considered for the best interests of transportation in California that much of the Federal Aid Secondary Highway funds be expended on county roads, the 1945 Session of the State Legislature passed the County Highway Aid Act, appropriating \$12,000,000 for the counties' use in matching the \$15,000,000 in federal aid secondary funds. The act stipulated that 87½ percent of the federal aid secondary funds received by this State be expended for improvement to county roads and bridges.

New Department Created

The task of administering these secondary funds and the formulation of construction programs acceptable to the counties, the Public Roads Administration, and the State was of such proportions that it was necessary to establish a separate department in the headquarters organization of the Division of Highways for the purpose. This department began functioning on June 1, 1945, and the excellent progress made in the work presents a splendid commentary on what can be accomplished by cooperative effort between agencies on three levels of governmental administration. In California this secondary program for improvement to county roads was started from scratch, beginning with the allocation of funds between the counties; selection of acceptable routes; the choice of needed improvement projects which would fit the money allocated; preparation of plans and specifications, either by the counties themselves, or, where they were not adequately equipped, by the State; then, upon federal approval, advertising for bids, award of contracts and construction supervision.

At County Level

One of the primary objectives of the Federal Aid Highway Act of 1944 in which the State is wholeheartedly interested is the development of effective administration and engineering at the county level. This is also the intent of the Collier-Burns Act of 1947. Most of the counties have shown improvement along these lines, and the close contact maintained between the Division of Highways and county personnel has been instrumental in furthering this objective.

To date the program of federal aid secondary improvements to county roads involves improvement of 917 miles at a cost of \$38,500,000. Of this total, 660 miles, costing \$28,900,000, is either completed or under contract.

Four-lane divided freeway approaching San Luis Obispo from the north on U. S. 101

While California converted its federal aid funds from the 1944 Act into highway improvements in the shortest possible time, many states were slow to obligate their federal aid funds. Consequently Congress made no federal aid available for the 1948-49 Fiscal Year.

New Federal Aid Bill

The Federal Aid Highway Act of 1948 authorized federal aid for the 1949-50 and 1950-51 Fiscal Years in an amount 10 percent less than the 1944 act. California received approximately $39,700,000 for the two year period of which $16,100,000 was for improvements on the Federal Aid Primary System, $9,200,000 for the Federal Aid Secondary System and $14,400,000 for the Federal Aid System in urban areas. Congress is now considering a new Federal Aid Bill and the amount of federal aid to be apportioned California in the future depends entirely on the final form and amount of this legislation.

Preparation of the postwar program had shown beyond the shadow of a doubt that state highway revenue, even when augmented by federal aid apportionments, was insufficient for adequate development of the State Highway System. The inordinate increases in traffic after the war accentuated the condition and it was apparent that the adequacy of California roads and highways was falling farther and farther behind.

Fact-Finding Committee

At the instance of Governor Warren there was appointed from the State Senate a Fact-Finding Committee on State Highway Finances. The findings of this committee clearly indicated the seriousness of the situation with the result that the 1945 Session of the Legislature created a legislative Joint Interim Committee on Highways, Roads, Streets and Bridges, comprising representatives from both houses. The work of this committee was thorough and of far-reaching importance to California.

In order to obtain a broad viewpoint on highway needs the committee established an advisory council which included representatives from many business and civic organizations. Members of the advisory council included representatives from the Private Truck Owners Bureau, League of California Cities, Mayor's Office of San Francisco, Los Angeles Traffic Association, Automobile Club of Southern California, Motor Vehicle Advisory Committee, Highway Development Association of San Diego, Western Oil and Gas Association, County Supervisor's Association, Associated General Contractors, California Transit Association, Bureau of Public Roads, Redwood Empire Association, California Farm Bureau Federation, California Retailers' Association, State Cham-

Freeway relocation of U. S. 101 south of San Luis Obispo looking north toward Santa Lucia Range

ber of Commerce, Greater Los Angeles Safety Council, Agriculture Council of California, California Railroad Association, Department of Motor Vehicles and Department of Public Works.

Study by Experts

Under the Joint Committee's direction an extensive and all inclusive study was made by independent engineers and highway economists of state highways, county roads and city streets. The results of this study were presented to the committee in three comprehensive reports:

(1) "Engineering Facts and a Future Program for Highways, Roads, Streets and Bridges," by G. Donald Kennedy.

(2) "An Analysis of Taxation for Highway Purposes in California," by Richard M. Zettel.

(3) "A Proposed System of Highway Financing for the State of California," by Bertram H. Lindman.

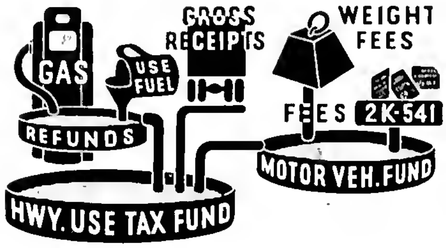
These reports covered traffic and financing studies for the entire highway network—state routes, county roads and city streets. The recommendations to the committee for proposed development were broad and all inclusive, featuring a long range plan for the entire State.

The value of the study and recommendations is attested by its reception by other state highway organizations when published late in 1946. It was probably the most complete highway study made up to that time and the fact that similar studies have since been made by some of the most progressive state highway departments speaks for its worth in highway development.

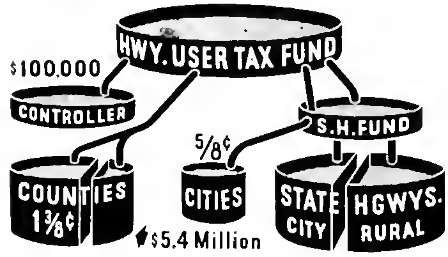
Turning Point

In the annals of California highway progress the 1947 Session of the State Legislature will be marked as a turning point. In 1909, the California State Legislature passed the first highway bond issue which established a state-wide highway system. In 1923, the Legislature changed the method of financing state highway improvement to the "pay as you go" plan by levying a tax upon gasoline. The third most important highlight in California highway history was the passage by the 1947 Legislature, in special session, of the Collier-Burns Highway Act.

SOURCE OF FUNDS



FUND DISTRIBUTION



Governor Warren, cognizant of the seriousness of an ever-increasing traffic congestion and the inadequacy of highway revenue for proper development had called a special session of the Legislature to consider and provide additional highway revenue. This special session ran concurrently with the Regular 1947 Session.

Collier-Burns Act

Based upon recommendations of the Joint Interim Committee, a bill was introduced and after many stormy sessions passed on to the statute books as the Collier-Burns Highway Act. Opposition to the bill was strong and backed by a powerful lobby sponsored by certain vested interests. However, the Governor stood firm in his demands for passage of an adequate bill and took a most active part in support of the legislation. It was one of the most stubborn and dramatic fights in California legislative history.

The Collier-Burns Act as finally passed by the Legislature was, of course, a compromise based on the bill originally presented. It did, however, follow in general the outlines of the committee's recommendations.

Gas Tax Increased

The tax on motor vehicle fuel was increased from 3 cents to 4½ cents per gallon and the net revenue divided between the counties, cities and the State. Registration fees for automobiles were raised from $3 to $6 per year and weight taxes on trucks were increased proportionately. After the costs of administering the Department of Motor Vehicles and policing state highways are defrayed from these two latter sources, the residue is transferred to the Highway Users Tax Fund for allocation between the counties and the State Highway Fund. Also under the Collier-Burns Highway Act the net revenue from the 3 percent tax on gross receipts of common carrier truck and bus operators is directed into the State Highway Fund.

Counties and Cities

The provisions of the act allocate to the 58 counties for development of primary county roads 1⅜ cents from the gas tax revenue, approximately $46,000,000 per year, plus a lump sum originally approximating 5½ million dollars annually but now adjusted to about 6½ million dollars; five-eighths of a cent from the gas tax or approximately $18,000,000 per year is apportioned to cities for use on major city streets other than state routes; and the remaining revenue of approximately $109,000,000 per year is allocated for state highway purposes. At the same time cities were relieved of the obligation and expense of maintaining state routes within their limits and this responsibility was transferred to the State.

To insure a minimum degree of state highway improvement in all counties the Collier-Burns Act carries provisions for stipulated minimum expenditures of state highway funds in each county throughout five-year periods. The minimums are based upon the relationship which the determined critical deficiencies on the state routes within the county bear to the total determined critical deficiencies on the State Highway System.

Looking to Future

For the first time in California highway history, legislation has been enacted which, with some degree of adequacy, looks to the future and provides a continuing system of furnishing revenue which is dependable and can be used as a basis for intelligent long range planning.

It is, however, estimated that there will be available annually for the first 10 years an average of about $76,000,000 exclusive of federal aid for construction on the State Highway System. While this is a substantial increase in revenue, it amounts to only $760,000,000 in 10 years as compared to the determined list of deficiencies on state highways in which needed projects total over 1½ billion dollars. It, therefore, becomes immediately obvious that it will be many years before more than the most critical of deficiencies on the State Highway System can be corrected.

Highways Division Reorganized

To meet the greatly expanded state highway construction program under the 1947 act it was found advisable to reorganize the Division of Highways on a broader basis more adaptable to administration of the larger volume of work. The comparative ease with which the reorganized department has moved into smooth operation on the enlarged program is evidence of the advisability of the reorganization.

Highway administrative organization in California has been distinctly of single executive control. It started that way in 1910 and continued that way for 37 years—the State Highway Engineer; Assistant State Highway Engineer; Surveys and Plans Engineer; Construction Engineer; Maintenance Engineer, and Office Engineer.

As the number of motor vehicles increased, the public became more demanding for better highways and provided additional revenue. This necessitated growth and expansion of the department. New functions were added—the Materials and Research Laboratory; the Equipment Department, then, with the cooperation of the Bureau of Public Roads, the State-wide Planning Survey, state routes were extended through cities and a department was necessary to handle city-cooperative projects. State aid to counties increased under the federal aid secondary program and a separate department was needed to administer this phase of development. Traffic congestion became such a major problem, it was necessary to set up an independent Traffic Department. The growth by this time having become so great, it became an economic necessity to establish a unified Stores Department.

New Plan Functioning

With the increase in size and variety of functions within the Highway Department coupled with the enactment by the 1947 Legislature of the Collier-Burns Highway Act, it became apparent that the single executive type of administration was inadequate.

After much study a plan for reorganization was put into effect late in 1947 and which is now functioning exceptionally well in handling the large expansion of the highway program.

Briefly the reorganization is as follows:

The headquarters staff was revamped by changing the old position of Assistant State Highway Engineer to Deputy State Highway Engineer and by establishing positions of five Assistant State Highway Engineers.

Work Divided

The work of the Division of Highways is divided so that four of these Assistant State Highway Engineers exercise executive authority over the following subdivisions: Operations, Administration, Planning, and Bridges. The fifth Assistant State Highway Engineer supervises personnel matters, service agreements and miscellaneous other functions. Upon equal footing with the five Assistant State Highway Engineers is the Chief Right of Way Agent who supervises all right of way matters. The Comptroller of the Division of Highways directs the administration of the accounting system, disbursements, and the internal audit.

District Changes

At the time the headquarters staff was reorganized, it was deemed advisable to revamp the organization of two of the 11 highway districts. These two metropolitan districts comprising the areas around San Francisco and Los Angeles were expanded with an administrative set-up following closely that adopted for the headquarters organization. Each of these two districts is functioning under the direction of an Assistant State Highway Engineer with the rating of Metropolitan District Engineer.

Under the reorganized Division of Highways, state highway development, revitalized by the Collier-Burns Act, will continue to advance at the maximum rate possible with the revenue provided by the act and by federal aid. Within the department constant forward improvement of both internal and external operations must be maintained if progress is to continue. While even a bare listing of engineering and operative improvements accomplished during the last seven years would be too voluminous for any normal report, there are certain accomplishments in performance of the several phases of highway administration which should be mentioned.

Traffic Data

Fundamental to the planning of highway development is the accumulation and analysis of factual data relative to the traffic which uses the highways.

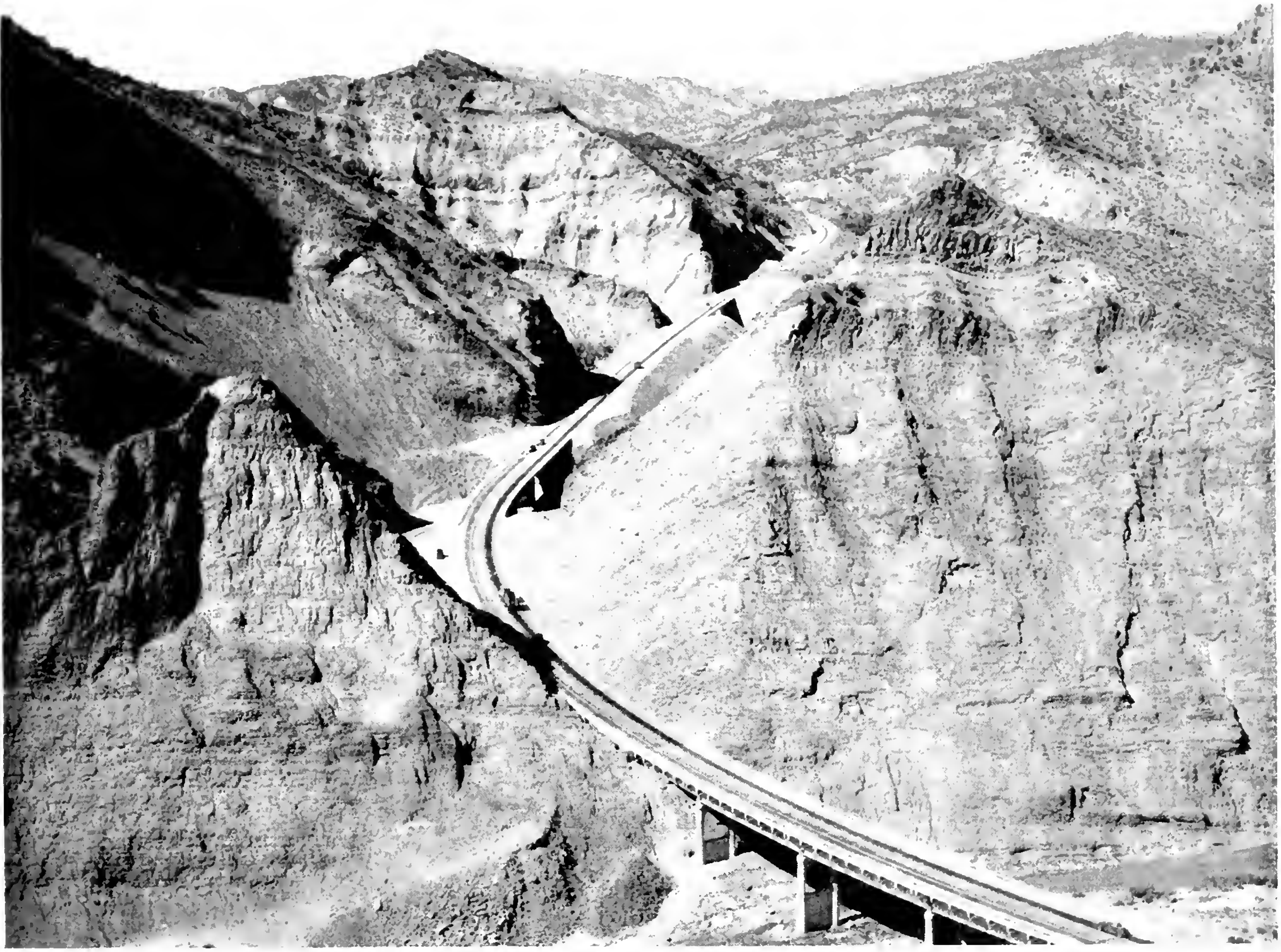
All reported accidents on the rural portion of the State Highway System, received through the offices of the California Highway Patrol are coded and tabulated. Special studies covering points of accident concentration and accident-prone sections are made, the accident pattern analyzed and, where possible, corrections are made.

Among the major sections studied were the Arroyo Seco Parkway, the Ridge Route at Grapevine, and the entire Feather River Route between Oroville and Hallelujah Junction. Corrective measures taken as a result of these studies were: Revisions in the median strip and emergency parking areas on the Arroyo Seco Parkway; a restricted speed zone of 45 miles per hour established on the Ridge Route near Grapevine; delineation and stated speed signs installed at various locations on the Feather River Route.

Included in research being performed is a special study covering the accident relationship of the various types of median strips on multilane highways.

Trucks Classified

A new truck counting procedure was inaugurated in 1945 which classifies trucks in terms of the number of axles instead of by light, medium, or heavy trucks previously used. This method, together with the information obtained by the systematic weighing of trucks at numerous locations throughout the State, which has made it possible to determine within closer limits the average weight



This is U. S. 99 through Piru Gorge on the Ridge Route

of trucks of each type, affords a means of determining the extent of the use of the highway system by commercial vehicles in terms of ton-miles which is most valuable in the structural design of highways.

Truck Paths Study

With the advancement in highway design and the increasing number and complexity of channelized intersections, grade separations, interchanges, on and off ramps, and divided highways, the dearth of knowledge of the paths which large trucks and trailers and tractor-truck, semitrailer combinations make on short radius curves became more and more critical. Last year the Division of Highways, with the cooperation and assistance of several bus and trucking operators who furnished the vehicles, conducted an exhaustive series of tests at a nearby airfield to determine the paths necessary to accommodate these large vehicles. A report of the results of the trials and providing recommended curve data and lane width is now being used as a guide by the design sections of the several districts of the Division of Highways. It also has attracted the interest of other state highway organizations and city and county engineering departments because of the common need for such information.

Origin and Destination Survey

New traffic engineering techniques are employed to obtain traffic data for planning new highways. Among the latest and most important is the origin and destination survey. These surveys are made in cooperation with the U. S. Bureau of Public Roads and the California Highway Patrol. The drivers themselves are asked to furnish information as to the origin and destination of their trip in addition to other pertinent information, usually by stopping them on the highway, but sometimes by home interview or other means. When these data are tabulated and analyzed, new highways can be located so they will provide the best possible service to the highway users for the money expended.

Cooperation with the California Highway Patrol Academy was instituted by presenting the subject of Traffic Engineering to classes of Highway Patrol

cadets. Several traffic engineers participated in this instruction, three to five lectures on the subject being given to each class of future highway patrolmen. Rudimentary knowledge of traffic engineering principles should promote better understanding of the mutual problems of the Highway Patrol and the Division of Highways and should result in greater over-all efficiency in the prevention of highway traffic accidents.

Yearly Programs

In the planning of highway development, programs are now prepared each year for succeeding five-year periods. Project reports outlining the basic features and estimated cost of each proposed improvement are analyzed and processed through headquarters of the Division of Highways before preparation of preliminary budgets.

As an aid to preparation of highway programs, on July 15, 1948, the California Highway Commission adopted a resolution establishing a procedure for the dissemination of information and the holding of hearings on all freeway projects where new location or major relocation is involved. These hearings are conducted by members of the commission, giving them an opportunity to hear, first hand, the reaction of the communities to the proposal being presented by the State Highway Engineer. The hearings are well publicized and give each interested citizen an opportunity to be heard. It is a function of the planning section to properly coordinate the action of the highway districts and to make recommendations to the State Highway Engineer for presentation to the California Highway Commission.

Budget Section Established

In October, 1947, a budget section was established as a separate entity for the purpose of more efficient and expeditious preparation of the division's budgets and their proper control once they were adopted. The necessity for this action became particularly urgent with the greatly enlarged program of highway work made possible by the enactment of the Collier-Burns Highway Act and the resulting increased revenues for highway construction.

The essential elements in any budget procedure are:

1. **Determination of probable revenue.**
2. **Recommendation for the allocation of available funds to specific uses.**
3. **Control of expenditures as allocated.**

With undertakings of the magnitude and complexity of those with which the Division of Highways is charged, it becomes physically impossible for those upon whom major decision rests to acquaint themselves with the immense detail involved. To assure both efficiency and expedition in the over-all job which the division has to do, this multitude of detail must, in some manner, be sifted down to those major essential elements which are of controlling value in final decision.

To assure that proper consideration is given to all items which go to make up the annual budget and, at the same time, to assist in expediting the final review and decision on these items, all candidate projects are subjected to a careful screening process.

Project Reports

Initially each individual project is made the subject of a "Project Report" setting forth simply and understandably the job under consideration with detailed statements of all pertinent facts involved and containing the definite recommendation of the District Engineer. These reports in turn are distributed to all headquarters departments for their study preliminary to thorough discussion in regularly scheduled conferences of all department heads presided over by the State Highway Engineer.

Obviously, the aggregate of funds which would be required to match the potential cost of all these proposals is so many, many times any possible expected revenue that only those showing the highest warrants can qualify for further immediate consideration. More exact detail as to probable cost of each of these is then prepared and this group, always representing a total outlay greatly in excess of currently available funds, forms the base for more extended scrutiny by the State Highway Engineer and the California Highway Commission in their determination of final selection for inclusion in the budget.

Process of Screening

In the assembly of this still very large and extensive group—although numerically greatly concentrated in comparison with the total which have been reviewed—care is taken to assure comprehensive coverage of the entire State Highway System, having in mind various legal requirements as to the allocation of expenditures between north and south county groups, and among the individual counties within these groups. Without this process of screening, or one similar, it would be extremely difficult, if not altogether impossible, for those charged with the final decision to allot the time required even for superficial review of all proposed undertakings. For assistance in final review, and to assure that all suggestions have been given attention, a condensed summary is prepared listing all requests received from the many individuals and organizations interested in particular locations or phases of the highway program.

Budget Control Major Function

With the inauguration of annual, in place of the former biennial budgets, and the provision for the letting of contracts in advance of the actual beginning of the fiscal year, the work of preparation and control of budgets has become a major function, continuous and unbroken throughout the year. The enormous increase in traffic and the consequent increased demands for more and more improved facilities, coupled with the fact of inadequate—even though substantially increased over those formerly available—funds, make the task of selection continually more difficult.

Engineering control of all phases of budgetary operations is maintained by a special section under the direction of the Office Engineer. The duties of this section include the review of planning programs, review of project reports, attendance at budget meetings where the recommended priority of future projects is determined for submission to the commission, the estimating of revenue for future budgets, the estimating of available funds in current budgets, the review of budgets and preparation of votes for commission action on necessary revisi-

Gas tax funds built this mountain highway with concrete center barrier on Ridge Route, U. S. 99

the preparation of documents necessary for Department of Finance approval of budget revisions and the keeping of records and making reports of all budget transactions, including revisions, allotments, savings, reversions and contingency reserve funds. Continual revision of budgets is necessary as bids for projects are opened and unforeseen conditions on projects create overruns or savings that require financing or reallocations.

Payments to Contractors

The Division of Highways has an enviable record of prompt payment to contractors for work performed. This fact enables contractors to finance projects with less cash and consequently at lower cost. The state benefits by the lower bids received. To achieve this end contractors' progress estimates must be processed for payment in the shortest possible time. The number of progress estimates per month varies from a low of 150 to a high of 270, and the monthly payments to contractors vary from three to eight million dollars.

The value of contracts under way throughout the State does not vary to the extent that it does in some other states where work is more seasonal in nature. In the last three years the value of contracts under way has varied from a low of $57,000,000 to a high of $97,000,000.

Design Section Enlarged

While design of each highway project originates in the District Office of the district in which the project is situated, the design features incorporated conform to standards adopted by the department and are subjected to review both in field and office by the headquarters design section.

So as to meet the increased volume of work since 1943, the design section has reorganized and increased its personnel. The increased volume of work and the increased engineering considerations that must be given to various features of the present-day highway, caused by the efficiency with which modern traffic must be handled, have resulted in the present organization of specialized sections. The design organization is now divided into sections covering structural design, intersection and interchange design, drainage, and special investigation and a review or liaison section. This latter section consists of five men whose special duties are to keep close contact between the districts and headquarters, to the end that there will be a minimum of lost motion or misunderstanding in the development of contract plans.

Realistic Budgets

Project reports have been developed during the past seven years. A form has been worked out for these reports for use by the districts which has resulted in complete information being made available to study the project and determine its appropriateness and priority for construction. This has resulted in more realistic budget preparation.

The policy of tying surveys into the California Coordinate System has been developed and progress is being made in this respect. It is a slow process but ultimately will result in a great saving in relocation of right of way lines, property corners and other survey points as well as making highway survey points useful to the general public through private engineers.

The freeway and expressway concept of design has developed rapidly during this period. Development of this type of highway has been expedited by many new design details which are resulting

in more efficient and safer use of freeways. This is especially true in intersection and interchange design where better statistical traffic information has resulted in the development of practical details such as acceleration and deceleration lanes, free-turning lanes, ramps designed to adequate standards, and development of the rolled gutter design. This latter detail results in better delineation of the edge of the roadway and the feasibility of building lightly designed shoulders, since they will be used for emergency parking only and will not be subjected to repetitive heavy wheel loads.

Standard Traffic Lanes

The general acceptance of the 12-foot traffic lane and wider shoulders has been accomplished during this period with its resulting increased safety and traffic capacity. Increase in pavement thicknesses and treatment of road bases with Portland cement both have added to the life and strength of California highway surfaces.

In cooperation with the Materials and Research Laboratory and the Construction Engineer, new design charts have been developed and placed in use so as to give a uniformity in determining the thickness of pavement and base. This has eliminated many uncertainties by developing better design practice. These charts have been made possible by the development and better use being made of statistical traffic information on the heavier loads using the highways and use of the 5,000-pound equivalent wheel load repetitions from this information.

Design of Pavements

The Division of Highways has made many changes and improvements in the design of concrete pavements which have made better riding and more durable pavements.

These include the use of forming strips for weakened plane joints that remain in concrete pavements and are finished over without edging, which eliminates the possibility of introducing surface roughness at transverse joints and results in greatly improved riding qualities. Several of last year's projects measured by the Bureau of Public Roads type of trailer roughometer under the auspices of the University of California show a degree of riding comfort never before attained in the entire United States.

Cement has been used to solidify the subgrade under concrete pavements in soils that are susceptible to softening and extrusion under rocking slabs. This solidification will extend the life of concrete pavements for a great many years.

Expansion joints have been eliminated in concrete pavement, thus removing the weakest point in pavement design. Many hundreds of miles of this design have been constructed. This should result in a considerable extension of maintenance-free service for concrete pavements.

War Time Maintenance

By January 1, 1943, the state highway maintenance organization was operating on a full wartime basis. The working force was at a minimum of approximately 2,150 men and their efforts were concentrated on upkeep of structures and traveled way and particularly on the portion of the highway system most used by wartime traffic. The special seasonal services, such as snow removal, which were necessary for the general welfare, were never neglected. It was fortunate that for the several winters during the war storms were well distributed, the snowfall was below normal, and damage from floods was comparatively slight. The protection work which had been done in previous years at many streams and known slide areas paid off during this period.

In 1943 the maintenance equipment was still in reasonably good condition. Here again the program of replacing equipment and of stockpiling essential materials, which had been undertaken in 1940 and 1941, made it possible for the limited maintenance forces to carry on with good results during the war years.

Military Hauling Damage

The surfacing on many secondary highways was seriously damaged due to heavy and continuous hauling of lumber products, aggregates, mining products, etc., as well as the movement of military equipment and supplies. With such exceptions the highway system was in reasonably good condition at the end of the war. This could not be said of the maintenance equipment. By 1945 the shop forces were having great difficulty in securing parts and in keeping the equipment in operating condition. At times as many as one-third of the motor graders, for example, were out of service. Frequently a unit would be tied up for several weeks lacking an essential part.

Prior to the war, the maintenance forces relied on renting privately-owned equipment for special jobs or as relief units in case of breakdowns. Equipment from this source of supply was not available during or immediately following the war.

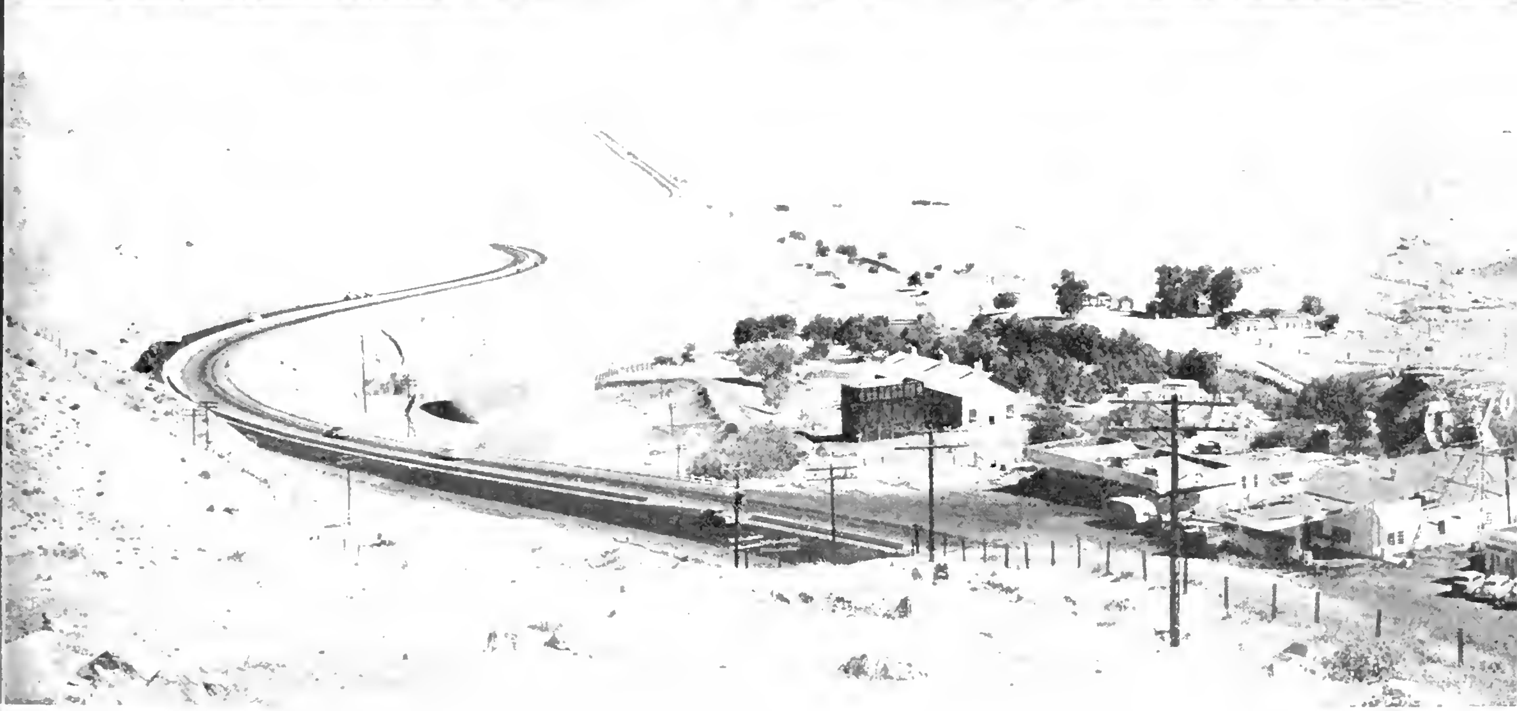
Equipment Shortage

The limitations, as outlined, on maintenance work existed from January 1, 1943, to a year or more after the end of the war. In fact it was not until 1947 that the situation eased insofar as the securing of equipment and many materials was concerned. It was necessary, therefore, to continue the maintenance work on a makeshift basis during the entire period. Advantage was taken of every expedient in order to render the most necessary services. Materials available for traffic lacquer, for example, were entirely unsatisfactory as compared to prewar specifications and when applied to the road had only about one-third of the life of the prewar lacquer. These factors not only increased the work of the maintenance forces, but also added greatly to the cost of the service rendered for various phases of the maintenance work.

During the entire war and postwar periods, every effort was made to keep the working force to a minimum. With the return of more normal conditions during the past two years, such efforts have been continued. In January, 1941, 3,100 men were employed. At that time, however, special effort was being put forth to get as much repair work done as possible in anticipation of restrictions on materials and manpower, which developed later.

Maintenance Forces

As of January, 1943, the maintenance field forces consisted of some 2,150 men including the office staff in the maintenance superintendents' offices. By July 1, 1950, this force was about 2,400 men. This compares to a normal prewar organization of some 2,500 men. This increase in force, however, does not represent a



UPPER—Old winding highway, U. S. 99, on Grapevine Grade, Kern County. LOWER—Same section after being modernized by Division of Highways. Both views looking north toward Bakersfield

return to prewar status. It has been a gradual development and made necessary by added functions such as assumption of maintenance of state highway routes in cities in 1948, as authorized by the Legislature, and more particularly by the increase in number of bridge and grade separation structures, as well as the necessity of making up for deferred maintenance, the increase in the number of traffic signals and highway lights and the addition of landscaped areas on freeways, etc., which require continuous concentrated maintenance.

Maintenance Routine

The maintenance work, in general, is of a piecemeal and intermittent character that does not lend itself to set times or procedures. It carries with it responsibility for routine patrol of the highways, emergency calls in case of accidents and

for special services such as storm damage and snow removal, etc., which require the continual attendance of a minimum crew. The special advantages of contract work are fully appreciated. It has been possible to keep the crew to a minimum by handling work under contract when the detail can be clearly specified and the time element allows of preparing and advertising a project. As a matter of fact, it would be impossible to keep up the highway surfaces with the present force and equipment except for the 300 to 500 miles of thin surface blankets which are placed each year under contract.

The current program of highway improvement carries with it a need for constant expansion of the maintenance work. The divided highway type of construction not only doubles the mileage of pavement, but also the number of structures, the miles of shoulders and, in general, also the area of right of way to be policed. In addition, of course, there are the grade separation structures on freeways, together with approaches and special facilities. Many of these layouts are elaborate with signals, lighting, etc., and require extensive maintenance. There is also a constant increase in demands throughout the highway system due to increase in traffic volumes, as well as for special services such as traffic stripes and snow removal. It also should be noted that both degree of activity and cost of maintenance are directly proportional to the volume of traffic. With the abnormal increase in California's population and the accompanying rise in both car and truck traffic required maintenance operations are greatly augmented.

Radio Communication

The Division of Highways radio communication system, which was in service during the war years under special emergency license, is now in process of reconstruction to high frequency type of service. Under the license granted by the Federal Communications Commission system this method of communication can be used for any phase of highway work. An installation has been made in the Eureka district area, as well as the Los Angeles area.

The system, which has been in use in the Redding, Marysville, Bishop and San Bernardino districts, will be changed to the high frequency type as rapidly as the men and materials are available to carry out the work. This method of communication is very useful in maintenance work and particularly in connection with snow removal and sanding operations. The operating equipment can get in touch with their headquarters immediately in case of any breakdown or unusual condition on the road. The supervisor is in a position to direct the assignment of the equipment to the points where it is most badly needed. He can also order replacement parts or shift the equipment from place to place with the minimum of delay. When the system is completed, as planned, very considerable savings are anticipated in the supervision and actual carrying on of the work. The public will be better protected in case of any road closures of other emergency and the routine work can be carried on more quickly and economically than is possible without such communication.

Equipment Department

The Equipment Department of the Division of Highways is a self-supporting unit established to supervise, maintain and account for all of the automotive, construction, and maintenance equipment owned by the division. Its chief income is derived from rental of this equipment to the other departments and districts of the Division of Highways. By this means all mechanical and motor vehicle equipment is efficiently and competently serviced and maintained, and the full proportionate cost of purchase, upkeep, and replacement of every piece of equipment of the Division of Highways is properly charged to each particular function or project on which it may be used.

Under the present organization the main shop in Sacramento handles not only the cars of the Headquarters Office, as well as some equipment for other state agencies, but also cares for cars, trucks, and maintenance equipment of the Stockton and Marysville districts. The Sacramento shop is tooled to handle construction of any special machinery for highways, such as paint striping machines, oil distributors, boring rigs, as well as special work which may be requested by other state agencies. There are 10 additional shops to serve the nine districts (other than Stockton and Marysville) and the San Francisco-Oakland Bay Bridge.

Value of Equipment

The inventory of the equipment department includes a total of 5,333 separate pieces of equipment. Of this number 1,035 units are passenger cars, 1,827 units are trucks of varying sizes and weights, and the remaining 2,471 units are made up of over 50 different kinds and types of construction equipment. The total inventory value of this equipment is approximately $13,000,000. This is an increase since the war of approximately $6,000,000.

Substantial standardization has been achieved in the sizes, types and capacities of many equipment units in common use. This has resulted in a saving of the required number of spare parts stocked and in more familiarization on the part of repairmen.

After six months of intensive study a new rental rate system was put into effect in October, 1949. The regrouping of the equipment serviced under the new system resulted in a reduction in the total number of different rental rates by approximately 130 individual rates. This innovation has resulted in a considerable saving in the preparation of rental reports and related accounting. Changes were also instituted in the accounting statistical section which will simplify and reduce the cost of future rental rate studies.

Bridge Information

Since 1943 a great improvement and advancement has been made in the method of securing foundation information for bridges. This is of utmost importance since an accurate determination of the bearing capacity of foundation materials has a major effect on the cost of bridges. Within the last two years very efficient foundation equipment has been developed and is in charge of an engineering geologist who has been well trained and has had valuable experience in this work. At the present time far more accurate and dependable information is being secured, which means a great saving in the cost of bridges. Incidentally, at the last National Meeting of the American Association of State

Highway Officials, the Bureau of Public Roads Bridge Engineer from Washington stated that the greatest concern through all of the states was the lack of sufficient foundation investigation, which resulted in an epidemic of settlements in bridges and other bad effects.

From conversation with bridge engineers in other states, it would seem that California has one of the best, if not the best, organizations and equipment to secure desirable results. It is impossible to state definitely the amount of money this has saved the State but it runs into many thousands and hundreds of thousands of dollars.

Stores Department

Since V-J Day in August, 1945, the Division of Highways, acting through the Department of Finance, has made large purchases of material from the War Assets Administration resulting in a very considerable net saving to the State. In order to take advantage of further savings and to expedite the buying and distribution of state-owned materials used in maintenance, design and construction of state highways, it was decided to organize a Highway Stores Department in April, 1947.

Subsequently, two central warehouses were established, one in the Los Angeles area serving the southern part of the State, and one in Sacramento to serve the northern portion. The headquarters offices of the department are located in the Public Works Building in Sacramento.

In general, the Highway Stores Department works in conjunction with the several headquarters departments and the 11 highway districts concerning the problems of securing materials and supplies.

Because of material shortages during and after the war, special emphasis was placed on the availability of materials. The procedures and methods developed during this period have proven adaptable to a permanent stores department in line with modern industrial practice.

Savings Effected

The purpose of the Stores Department is to provide storage facilities for those commodities capable of being purchased in large quantities with consequent reduction in price and to afford rapid distribution from warehouses with a minimum of delay and paper work. For instance, under the old system it was found that every item was purchased on an average of 12 times per year. The purchase of 1,000 items, 12 times each, results in 12,000 purchase orders and 12,000 bills to pay. When considered that each purchase results in multiple copies of local requests, requisitions, purchase orders, receiving records, shipping records, invoices, bills, transfer records, schedules, and various correspondence, the amount of paper work is overwhelming. Purchasing highway materials on a wholesale basis once or twice a year rather than on a retail basis of 12 times per year, not only results in substantial monetary savings but also in large savings in paper work.

Typical view of new four-lane divided highway developed from existing two-lane highway in Monterey County

Large Scale Buying Power

Except in unusual cases, under the former method, each purchase was subject to a minimum delay of 30 days between the time of originating a requisition and delivery of the material; whereas, the Stores Department at present stocks approximately 4,000 items and attempts to maintain 48-hour delivery service. It is estimated that the number of items carried by the warehouse will double within the next year.

The prime consideration is, first to expedite the flow of materials to points of usage, and second, to realize a savings by using the large scale buying power of the Division of Highways. The Stores Department is a sound engineering addition to supplement the other departments of design, construction and maintenance. The analytical study of needs and usage effects a substantial savings in expenditures, which are both direct and intangible; direct savings insofar as purchase price is concerned and intangible insofar as savings can be effected in lost time waiting for delivery.

Duplication Eliminated

Further reasons for organizing a Stores Department was that there were five separate groups in headquarters office with a total personnel of 16, whose functions consisted of procurement of materials in some form or another. These

separate groups have been incorporated into the new department. Each has brought his special problems to the new department with the result that the Stores Department has broadened beyond the scope of merely warehousing and distribution of supplies.

Additional Activities

Some of these additional activities are included in the following:

1. Initiation of projects for large quantity production such as the purchase and/or fabrication of steel fence posts, guide posts, signs, piling, survey stakes and miscellaneous other items.

2. Analyzation of the changing needs for materials and supplies in the line of economy, availability, and extent of usage.

3. Maintenance of an organization for the procurement of surplus material from the War Assets Administration. Purchases from this agency to date represent a cost of $881,612 with a commercial value of $1,461,337.

4. Supervision and maintenance of Public Works Buildings, together with the custody of property and equipment.

The distribution of materials, property accountability and accounting work in connection therewith, which was formerly performed by the districts and other departments, has been taken over in part by the Stores Department.

The total personnel of the new department is now about 55 employees.

Construction Cost Index

Rapidly changing economic conditions since the end of the war made it necessary that some reliable method of measurement of highway construction costs be devised which would reflect the changes in the cost of highway work due to economic conditions alone, independent of engineering factors, such as design standards, which also influence costs.

After considerable study and research, including a study of other cost indexes, the California Highway Construction Cost Index was developed. It is believed that this index is an accurate barometer of changes in highway construction costs in California due to economic conditions.

California Index

While the California index follows the same general trend of other indexes, such as the Bureau of Public Roads Composite Mile Index, there are some very significant differences. The Bureau of Public Roads index reached a peak of 230.9 (1940 = 100) in the fourth quarter of 1948. The California index reached a peak of 216.8 in the first half of 1948. In other words California's peak in highway construction costs was reached sooner and was 14 points lower than for the United States as a whole. The B.P.R. index declined 28 points to 202.9 in the fourth quarter of 1949. In the same period the California index declined 38 points to 178.8 for the fourth quarter of 1949. In other words, California's index decreased faster, by 10 points, and is now lower, by 24 points, than the national average.

Bid Advertising

While there are many reasons why the Division of Highways can get better prices from highway contractors than the national average, it is believed that by far the greatest influence is the careful planning of the advertising schedule. This careful planning, in contrast to the erratic advertising practiced in some states, has resulted in a saving of over 7½ million dollars in the last 18 months. This 7½ million is the difference between actual bid prices paid and the prices which prevailed nationally as indicated by the Bureau of Public Roads index.

The continuation of cost analyses and very careful planning of advertising schedules is an absolute necessity to insure that the motorist receives the maximum amount of highway improvements possible from the funds available.

As an indication of the competition which prevails among highway contractors for projects advertised by the Division of Highways the average number of bidders per project is the best measure. The average number of bidders per project has increased from 5.6 in the 1947-48 Fiscal Year to 8.5 for the first three months of 1950.

Keen Competition

The present keen and healthy competition in bidding on California highway work is to a large degree the result of the hundreds of millions spent in this State during the war. Many large midwest and eastern contractors came to California for wartime contracts and, finding that operations could be conducted during 9 to 12 months of the year, have kept their Pacific Coast organizations intact by bidding on California projects. There are now over 650 contractors prequalified with the State to bid upon state highway construction. Prequalification ratings are based upon a review of a contractor's financial statement, experience record, and equipment inventory. While the ratings fall in several brackets it is sufficient to state that 359 are rated up to a quarter of a million dollars and 158 are rated $1,000,000 dollars and over. The total rating of all prequalified contractors is approximately $1,375,000,000. This is a clear indication that the contracting industry in California is ably financed and equipped to undertake construction up to many times the value of any program which the State might inaugurate.

Right of Way Department

During the past seven-year period, practices and procedures in the State Highway Right of Way Department have been completely revised, modernized and streamlined with the result that California is now recognized as having the most efficiently operated public land acquisition organization in the Nation.

Prenegotiation-appraisal procedure as initiated with a fully equipped valuation section, which has been in operation for five years, has tremendously reduced overhead cost in right of way acquisition and has resulted in fairness and equity to all affected property owners. This is conclusively proven by the fact that during the past fiscal year 5,125 parcels of right of way were acquired by negotiation, which of course means meeting of the minds between the property owner and the State, while it was only necessary to acquire 63 parcels by trial in eminent domain proceedings.

Procedure Inproved

Every phase of modern state highway right of way acquisition procedure has been improved during the last five years with a thoroughly accurate record having been installed to keep track of every phase of the work.

A land economics research section has been created under which the actual effect of every type of highway development that has been completed is studied

over a period of two to five years to determine the actual and conclusive effect of such development thereby eliminating guess work in determining market value and damages.

Further advance in expediting right of way matters prior to construction operations has been accomplished during the past three years by the establishment within the district offices of a section devoted to handling the readjustment of utilities within right of way limits.

Engineers Recruited

Employees of the Division of Highways numbered about 5,700 at the beginning of World War II. This number was reduced by entrance of members of the department into the armed services to a low of about 4,200 in January, 1944. Engineering personnel was reduced to a low of 900 in December, 1945.

At the time the postwar program was activated, the greatest personnel deficiency was the lack of trained engineers. A vigorous recruiting program was initiated for young engineers which has increased the engineering personnel to about 2,500 at the present time and the shortage no longer exists. A veterans on-the-job training program was initiated and carried on during the postwar period. Many veterans have completed the training course and attained the grade of junior civil engineer.

While the total personnel of the Division of Highways is now about 7,100, compared to about 5,800 in 1941, it should be pointed out that this increase is less than the increase in volume of work over the prewar period. One of the factors which made this possible is the reduction of maintenance personnel from about 3,500 in 1941 to about 2,700 in 1949 due to the policy of letting work to contract that was formerly done by maintenance personnel. Maintenance personnel employment represents one employee for each five and one-half miles of the State Highway System.

Legislature Creates Institute

In 1947 the Legislature appropriated funds to establish the Institute of Transportation and Traffic Engineering in the Department of Engineering of the University of California at Berkeley.

This institute has undertaken:

(1) To carry on research work in the street and highway problems. The Division of Highways is joining with the institute on some of these projects and cooperating in a consulting capacity on many others.

(2) To carry out undergraduate and postgraduate courses in highway engineering in order to furnish men needed in the accelerated California highway program.

(3) To conduct an annual three-day conference or road school for the benefit of city, county and state engineers engaged in street and highway work, at which speakers of both national and local prominence are presented. The conference in Los Angeles this year had a registered attendance of 392.

(4) To conduct extension lectures on street and highway subjects in various cities of the State for the benefit of the city, county and state engineers engaged in this work.

The Division of Highways is cooperating very closely with the Institute, particularly in the extension work, by furnishing some of the lecturers and is using this extension work as a form of in-service training for its own engineers. At a recent meeting in Berkeley over 200 engineers from the Design Department of the Division of Highways were enabled to hear a representative of the U. S. Bureau of Public Roads from Washington, D. C., present the latest developments in freeway design.

War Changes Traffic Calculations

During the decade prior to the war State Highway Department worked out projections of traffic increases for 10 to 20 years in the future. These projections were based upon all available information relative to anticipated growth of population, motor vehicle production and similar items. Anticipated population growth included factors which were considered adequate for trends of migration.

The Division of Highways was convinced that the projections provided a sound basis for future planning, until in 1939 and 1940, preparations for war made it increasingly evident that industrial expansion and development of military establishments in this State were invalidating the calculations.

When the United States entered the war it could be seen that the Pacific Coast was in for unprecedented growth, the extent of which could not be gauged by any previous experiences.

In 1940 California's population was 6,907,387, today it is estimated at nearly 11,000,000, an increase of over 4,000,000 people in 10 years—57 percent—and still growing at a rate of from twenty to twenty-five thousand per month.

Motor Vehicle Registrations

During this same 10-year period, motor vehicle registration rose from less than 3 million to over 4½ million, an increase of 63 percent. In addition to the 4½ million registered California vehicles, about a million out-of-state cars use the State's highways each year. Another factor which must be given consideration is the ever-increasing percentage of trucks included among the registered vehicles. Current traffic counts on rural state highways show that 18 percent of the vehicle miles traveled on California roads are generated by trucks.

It is the two interrelated factors of increase (population and motor vehicles) that have produced the enormous volumes of traffic and resulting congestion existent on California highways.

Congestion is, of course, most severe in the urban areas and of prime importance to the over-all development of the State Highway System is the provision of adequate highway facilities on those state routes in urban locations where congestion is most critical. In solving the problem of traffic congestion, first attention must be given to increasing the capacity of major arteries.

Freeway Development

In accomplishing the needed arterial improvement, development of four-lane divided highways and freeways is a major effort. The reason for such a policy is quite obvious. Freeway construction involves the separation of opposing lines of travel, the elimination of cross-traffic, and control of access to the freeway. It is axiomatic that it is easier and safer to drive where there is no opposing traffic and further that it is easier still and more safe to drive where cross-traffic and left turns do not have to be considered.

This photograph was taken north of Midway looking toward Dixon in Solano County and shows bridge units which converted this section of U. S. 40 into a four-lane divided highway

Analysis of traffic flow shows that on an uninterrupted highway, where nothing can cross or stop the movement of vehicles, traffic can be moved along at a rate of 1,500 cars per lane per hour but, when one stop signal is installed, movement is slowed down to 800 cars per hour.

In a similar vein of comparison it may be noted that a truck equals four ordinary automobiles in space required on a highway in flat country and the space of six cars on a foothill road. It can readily be understood, therefore, that the phenomenal increase in truck transportation which has occurred in California has added materially to the highway problem.

These, then, are the supporting facts behind the Division of Highways policy of freeway development in both urban and rural areas: They are safer; they make driving easier; and they move traffic.

Freeways Expensive

Such construction is expensive, requiring as it does, wide right of way, separation structures, extensive lane channelization and, at some locations, outer highways. In rural areas four-lane divided highways cost from $200,000 to $300,000 a mile including right of way. In urban areas the cost may run as high as $6,000,000 a mile including right of way. It is expensive development, but on routes carrying large volumes of traffic it pays dividends in economic savings and safety.

There has been and still exists opposition to the State's freeway policy. This opposition stems largely from minority groups, some of it organized by promoters of self-interest. The short-sighted viewpoint of such groups considers only the possibility of short-lived increase of local business, neglecting the greater economic values of long-range transportation development. In their hue and cry against freeway construction such groups continually cite what they term the "wishes of the people," referring, of course, to their own small clique, ignoring completely the fact that state highways are for service to traffic and that traffic is made up of people in motor vehicles and that on heavily traveled routes the number of people benefited by high standards of improvement far exceeds the small group which may object to some particular project.

Freeways Up Property Values

This opposition to modern highway development fades rapidly through the presentation of the facts. For instance, opponents to freeway development have claimed that construction of such projects destroys property values out of all proportion to the value of the improvement. This argument has been disproved by the actual facts in communities now being served by freeways. Unless congestion is eliminated in any given area property values will decline. Unless encroachments which interfere with the efficiency of the highways which we build are prevented, the money expended for the improvement is wasted.

Some years ago gas tax money was used to build a 25-mile stretch of highway out of Los Angeles which was expected to relieve considerable congestion in the city. A four-lane *undivided* highway was built and immediately became a heavily traveled route. Hundreds of small businesses were attracted to the road side and within two years after construction it became necessary to post 14 miles of the route with 25 mile an hour speed limit signs and accompanying traffic signals. The original purpose—that of moving traffic fast enough to relieve congestion—has been defeated. Instead of providing a major traffic artery only, a new business thoroughfare had been built and now another route must be provided to accommodate the traffic which the original highway was intended to carry.

Benefits to Property

In the files of the Division of Highways are numerous letters from owners of property located along freeways and served by proper outer highways testifying to the benefits with which they and their businesses have been rewarded by the elimination of traffic congestion

and hazards. Conversely, the building up of congestion at locations where arterial construction has been undertaken without division of travel lanes and control of access and cross-traffic, property values decline perceptibly.

While development of freeways on routes carrying heavy traffic volumes is a major policy of the Division of Highways and the State Highway Commission, it by no means overshadows the aim to raise the standards of traffic facilities throughout the entire State Highway System. Under the Mayo amendments to the Collier-Burns Highway Act, state highway improvement must be made in every county within each five-year period. This provision limits concentration of activity and insures against the possibility of any county going without state highway improvement for any considerable length of time.

Volume of Construction

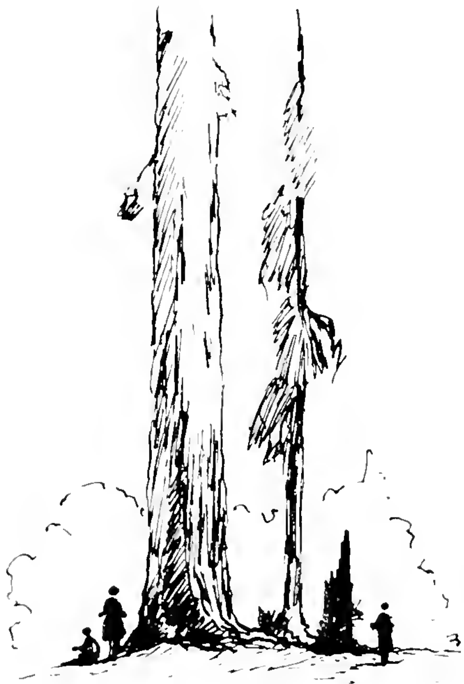
As a gauge to the volume of highway construction administered by the Highway Commission and the Division of Highways, it may be noted that in the four and one-half years after the end of the war contracts with a construction value of $297,513,000 were awarded, $181,715,000 of which have been put under way since the Collier-Burns Act became effective. In addition, there were outstanding calls for bids for proposed work totaling $14,581,000. Of the total contracts awarded in the postwar period, $164,043,000 or 55 percent were for the construction of freeways throughout the State in both rural and urban areas.

That highway construction activities will be held at levels comparable to the accomplishments of these past few years is indicated by the $66,000,000 state highway budget for the fiscal year ending June 30, 1951. Of this construction proposed for the coming year, contracts amounting to $2,292,000 were awarded on April 1st under the provision of the Collier-Burns Act which permits award in advance of the beginning of the fiscal year.

In spite of the progress that has been made in the construction of modern highways, notably freeways, these accomplishments seem very small indeed when compared to the enormous task which remains ahead of developing the entire State Highway System to such modern standards that congestion and delay no longer exist.

This objective can be met, as evidenced by the modern highways and freeways that have been completed in the postwar period. The engineers of the Division of Highways have the experience and ability to plan, design, and construct a modern highway transportation system which is so vital to the economic well-being of the State. The contracting industry has the organization and equipment to do the actual construction.

The time required to do the job is now only dependent upon the funds available.



Chapter XVII

Redwood Highway

By Marsh Maslin
Redwood Empire Association

Back in the teen age years of this century highway travel in The Redwood Empire (we use the word "highway" humorously) was so rough and tough that it was a three-day automobile trip from San Francisco to Eureka, if you could make it at all.

In those years if you wanted to take your automobile across the Golden Gate to Marin County you practically had to get a special dispensation from the operators of the passenger ferries—and then drain all the gasoline from your car's tank and have it pushed on and off the ferry.

There were no bridges across the Russian River at Jenner, or across the Klamath River, and the only passage was by crude ferry. Grades were dreadfully steep wherever you went. The roads were narrow and winding and rutted and in the northern part of the Redwood Empire they were surfaced with puncheons—redwood slabs laid crossways.

Rough Traveling

Few traveled then for what may be termed pleasure and there were many places to which you couldn't travel at all except by foot or on horseback.

Travel conditions were probably the worst in the State in the Redwood Empire, which did not bear that name before 1925. The very magnificence of terrain which has made it into an incomparable tourist attraction stood in the way of easy travel in the first quarter of the twentieth century. The dramatic coastal region with its many inlets—the ridges and ravines and peaks of the Coast Range—the mighty redwood forests of the giant sequoia sempervirens—the great rivers such as the Russian, Navarro, Eel, Smith, Klamath and the Rogue (of Josephine County, Oregon)—all these tremendous factors in the Redwood Empire's popularity today made travel arduous and sometimes even torturing. They were also to make construction of modern highways a costly undertaking.

When the people of California some 40 years ago voted their first bond issue of $18,000,000 for a modern highway system, that seemed a tremendous sum of money. But in the light of the huge

Russian Gulch Bridge in Mendocino County, one of the interesting sights in Redwood Empire

amounts voted and appropriated since then for California's modern highways, $18,000,000 now seems like small change . . . In fact, from January 1, 1912, to June 30, 1949, California spent $125,-401,956 for highway construction, reconstruction and maintenance in the eight Redwood Empire counties of California alone. These counties are San Francisco, Marin, Sonoma, Napa, Lake, Mendocino, Humboldt and Del Norte.

Dream of Better Highways

The most northern of the Redwood Empire counties is Josephine in Southern Oregon. When the Redwood Empire came into being less than 30 years ago, the people of that region had their troubles, too, and also encountered skeptical opposition to their dreams of better highways. At that time an automobile trip from Grants Pass to Crescent City in California's Del Norte County required 14 hours of travel, in spots reduced to four or five miles an hour. (Now a resident of Grants Pass can drive over to Crescent City to lunch with friends and be home again in time for an early dinner.)

Many people doubted that a fine modern highway system would be possible in the Redwood Empire and the Oregon State Highway Commission looked askance at the high costs involved. One of its spokesmen once said that it would cost a king's ransom for California to link its highways with Oregon's, and if California ever spent that much money it would be time for Oregon to put a modern highway through. Since then, Oregon has spent over $3,000,000 on Redwood and Oregon Caves Highways in Josephine County, strong links in the Redwood Empire's highway system.

First Construction

Even after the State of California went to work building good highways to take the place of the narrow roads the counties that were to be members of the Redwood Empire did not fare too well on appropriations. The now famous Redwood Highway was one of the first in the present empire system to come into being. An interesting phase of its construction was the use of San Quentin inmates, with their first camp near Laytonville in Mendocino County.

James A. Johnston, later to become nationally famous as warden of Alcatraz

Section of unpaved Redwood Highway before State took it over

prison, was warden of San Quentin in 1915 when the first convicts were used. He remembers that the camp was in a virtual wilderness. Supplies were brought by ship to Westport above Fort Bragg and carried by trail to the camp. No refrigeration was possible and the meat was hung from trees to keep it cool and out of reach of wild animals.

The men bunked on the ground, built rude structures in the trees, or lived in hollows in the base of the great redwoods. The famous Tree House at Lilley Redwood Park, 193 miles north of San Francisco, housed about 20 workers. At first the men from San Quentin did only the rougher work, such as making cuts and filling and blasting under supervision of Division Engineer Francis Somers; but later they did much of the surfacing of the highways.

Association Formed

The great redwoods were themselves a hindrance to highway construction, and some of them had to be removed. At a somewhat later period, on a project above Orick in Humboldt County, it was necessary to cut down over 2,000 giant redwood trees in a distance of about 26 miles, in order to make possible the construction of a road of reasonable width.

Soon the citizens of the counties, sons and grandsons of the pioneers who had come to this region during the Gold Rush and afterwards, realized that they would get nowhere by divided effort to win appropriation of funds for highway construction.

The present Redwood Empire Association first came into being in 1920 as the "Northbay Counties Association" at a meeting held in Santa Rosa, after the northbay counties discovered that they were securing comparatively small state (and federal) highway construction appropriations—mainly because they were competing each with the other and losing appropriations to other areas.

The counties decided to pool their funds, ideas, energies and manpower, unite on a joint cooperative program and support each other. The wisdom and material value of this policy has since been demonstrated in terms of millions of state and federal highway funds allocated since then.

The region was not even named the "Redwood Empire" until 1926 after the association was reorganized in 1925 and christened the "Redwood Empire Association" by its then new General Manager.

Campaigns for Better Roads

The Redwood Empire Association is unique among highway and tourist development organizations of the Nation. Its relations with the California High-

Approximately same section of Redwood Highway as shown on opposite page as it looks today

way Commission have been friendly and mutually helpful, but it does not exist merely to show up at commission hearings and request appropriation of state funds. It has campaigned vigorously and successfully, for years, in behalf of state and federal appropriations of money for the commission to spend in the entire State—out of which state highway construction in the Redwood Empire is financed.

Through its efforts the tremendous scenic, historical and recreational attractions of the Redwood Empire have been publicized to the entire Nation and the world. Great increases in tourist and vacation travel have resulted, achieving more and more tax money for Highway Commission use—population in all nine counties of the empire has grown greatly—hundreds of excellent tourist accommodations have been developed everywhere—all business and industry in the empire has been increased mightily through the mutually helpful cooperation of the Redwood Empire counties and the California Highway Commission, working jointly with the Golden Gate Bridge and Highway District.

Douglas Memorial Bridge

Travelers who cross the Klamath River in southern Del Norte County on the magnificent Douglas Memorial Bridge find it difficult to imagine a time when the river was traversed only by a little raft ferry carrying but three or four automobiles . . . and then only when tide and weather permitted. A $500,000 special appropriation was obtained to bridge this river. A similar raft ferry accommodated the few motorists who crossed the mouth of the Russian River on what is now known as the Shoreline Highway. A modern bridge under joint highway district proceedings with Highway Commission cooperation, was financed and built to take the place of the ferry. At that time motorists on that coast road had to open and close gates between cow pastures every few miles.

The Division of Highways did not merely improve old highways; much of its work has been construction of highways where none had ever existed. For instance, there were no highways on the now populous east shore of Clear Lake in Lake County and the Highway Commission had to be taken in boats to inspect the sites where the citizens of that county wished a new road built.

The original Cloverdale-Hopland sector led over the old road, narrow and twisting, steep and dangerous. On a new location, more than $1,300,000 was spent for a new sector. To the south a main highway ran over the old Corte Madera grade and all the highways were below standard. In many places, latest type highways, costing millions, have replaced the substandard highways.

Obstacles Overcome

Difficult engineering obstacles had to be conquered in constructing these highways. Streambeds were moved, rocky cliffs and mountains were blasted, deep canyons and wide rivers bridged, great trees were felled and acres of dense undergrowth hewn out. It was a task for giants and it was achieved.

In 1933 certain county roads were taken into the State Highway System by legislative act, a tremendous advance promoted by the Redwood Empire Association and its supervisors' unit, working with the Highway Commission, State Division of Highways and many civic organizations in California.

Great sections of the Shoreline Highway, through a spectacularly beautiful region, were taken in—as were other highways in San Francisco, Marin, Napa, Sonoma, Lake, Mendocino, Humboldt and Del Norte Counties.

Another tremendous achievement in roadbuilding was construction of that famous "highway in the sky," the Golden Gate Bridge. Commodious though the great automobile ferries were, it early became evident that the Golden Gate had to be spanned if development of the Redwood Empire was to continue. Leaders of the empire fought for years for this mighty improvement, and at last they won their point, organized the Golden Gate Bridge and Highway District and in 1937 completed the Golden Gate Bridge, longest and tallest single-span suspension bridge in the world, at a cost of $35,000,000. It links San Francisco, a Redwood Empire county (southern gateway), with the northbay counties of the empire. It serves local and interstate traffic of all types traversing the state and interstate highway systems.

Millions Are Spent

The spending of millions for modernization of the highways of the Redwood Empire has had a tremendous effect on the economic development of all this part of Northwest California and Southern Oregon. Industry and population have grown and now millions of

Douglas Memorial Bridge over Klamath River at Klamath

tourists and vacationists visit the empire who would otherwise be unable to do so.

The Redwood Empire Association's widespread and intensive activities in publicizing the attractions of the empire has enormously increased tourist travel to San Francisco.

These visitors cross the Golden Gate Bridge to visit Muir Woods and other Marin County attractions, including the beaches; they travel to the Russian River section, to Fort Ross, to the Valley of the Moon, to Sonoma's Mission and other historical sites; they see the great vineyards of Napa, Sonoma and Mendocino Counties, the all-year mineral springs health resorts of these counties and Lake County, the attractive resort areas of Clear Lake, Blue Lakes and other sections; they drive up the Shoreline Highway to the grandly scenic region along the coast and linger long in the great redwood forests of Mendocino, Humboldt and Del Norte Counties; they hunt, fish, swim, ride, relax; they visit the Oregon Caves of Josephine County and enjoy vacation trips that would otherwise be impossible if it were not for the astounding achievements of the California Division of Highways in building the highways for which the State Highway Commission appropriates money.

Nonprofit Organization

Expenditures by vacationists benefit state, county, city and district treasuries —particularly motorists who must pay gasoline tax, the same as California and Oregon residents. These visitors must also pay sales tax on meals and commodities purchased; their expenditures enhance pay rolls and increase purchasing power benefiting all lines of enterprise.

The Redwood Empire Association which works so closely with the Highway Commission and its staff is a grass-roots organization. It is nonprofit and semi-governmental and its activities and campaigns are determined by the taxpayers of the Redwood Empire. Recommendations are established and policies prescribed by the constituent counties through the respective county boards of supervisors.

Each year a "Master Schedule of Recommendations" of highway construction projects is drawn up by the boards of supervisors for submission to the Highway Commission and for inclusion in its future budget. The Redwood Empire Supervisors Unit works closely with the commission and appears at its monthly meetings with local delegations organized by the association. The Golden Gate Bridge and Highway District works just as closely with the REA and it is also represented at the commission's hearings by its officers and directors.

The Redwood Empire counties and their Redwood Empire Association are profoundly aware of the accomplishments of the California Highway Commission and the State Division of Highways, in building and maintaining the Redwood Empire System of Highways. They treasure this friendly and sympathetic relationship with the commission and staff members and pledge themselves to maintenance of this valuable cooperation in the future.

Chapter XVIII

Maintenance

By W. A. Smith, Assistant Maintenance Engineer

The maintenance of roads in California has been important since the early days. The users of the emigrant trails had difficulty in this regard. A more or less typical example is the Carson route which crossed the mountains south of Lake Tahoe, one branch leading down the ridge to Placerville and Diamond Springs. It is reported that by 1861 the entire distance from Placerville to Lake Tahoe was sprinkled every day during the summer, and in the winter, large sums were spent to press down the snow so that travel should not be interrupted. In view of the equipment available and the stage of development, such work represented a major maintenance effort.

There was also a traffic problem even in those days. The estimated amount of business done per annum over this mountain road in 1861 and 1862, according to Bancroft in "Chronicles of the Builders," was as follows:

30,000 tons of freight	
@ $100 per ton	**$3,000,000**
36,500 passengers	
@ $30	**1,095,000**
Meals and express	**125,000**
	$4,220,000

Former teamsters on the Placerville road often reported a detention of several days in the passage from Virginia to Placerville, occasioned by the difficulty in passing loaded wagons going in the opposite direction, which constituted a continuous train in the narrow grade.

In the Third Biennial Report of the Department of Engineering covering the period from December 1, 1910, to November 30, 1912, the history of the so-called "State Roads" and "State Highways" is detailed at some length. The road from Placerville to the state line near Lake Tahoe was adopted as a state road in 1895. In 1900-1901 a stone bridge of 81-foot span was constructed across the American River, which exhausted all the funds available for maintenance or improvement on the road. In 1903, $8,000 was appropriated for maintenance which was expended largely in repairing and rebuilding culverts and bridges, of which more than 80 existed along the road.

Highway maintenance as a branch of engineering began to develop with the improvement of the state highways in 1912. It was the policy in the early days for the State to take over for maintenance only those sections of the state highway which had been improved. It was not until 1925 that the State assumed responsibility for all routes designated as state highways. The development of the maintenance organization and work as now established began at that time.

During the war years the state highway maintenance forces, in common with many similar organizations, had gone through a serious adjustment period. In January, 1941, some 3,100 men were employed. At that time special effort was being put forth to accomplish as much repair work as possible in anticipation of the restrictions on materials and manpower which later developed. Within a short time the force had been reduced to some 2,150 men, including the office staffs in the maintenance superintendents' offices. This force was employed to the end of the war.

The wartime activities carried on in the intervening years had increased the need for maintenance work. The volume of truck traffic had increased on many routes and the average weight of loads had also increased. The need for lumber, aggregates and products of the mines and the development of military establishments had not only caused a great increase in traffic on secondary, as well as primary routes, but had also extended the hauling period to a year-round basis. This latter development became a most serious matter, particularly in timber-producing areas.

Wartime Traffic

The efforts of the maintenance forces were concentrated on the upkeep of structures and traveled way and, of course, on the routes most used by wartime traffic. The special services, such as snow removal, which were necessary for the general welfare, were never neglected. It was fortunate that for the several winters during the war storms were well distributed, snowfall was below normal, and damage from floods was comparatively slight. The protection work which had been carried out in previous years at streams and known slide areas paid off during this period. Nevertheless, the administration staff of the Maintenance Department was concerned each winter season, as any protracted storm period or extensive storm damage would have created a disaster period for the limited field forces.

In 1943 the maintenance equipment was still in reasonably good condition. Here again the program of replacing equipment and of stockpiling essential materials, which had been undertaken in 1940 and 1941, made it possible for the limited maintenance forces to carry on with good results during the war years. The surfacing on many secondary highways was seriously damaged due to heavy and continuous hauling of lumber products, aggregates, mining products, etc., as well as the movement of military equipment and supplies. With such exceptions, the highway system was in reasonably good condition at the end of the war. This could not be said of the maintenance equipment.

Shop Problems

By 1945 the shop forces were having great difficulty in securing parts and in keeping the equipment in operating condition. At times as many as one-third of the motor graders, for example, were out of service. Frequently a unit would be tied up for several weeks lacking an essential part. Prior to the war, the maintenance forces relied on renting privately owned equipment for special jobs or as relief units in case of breakdowns. Equipment from this source of supply was not available during or immediately following the war. The limitations, as outlined, on maintenance work existed to a year or more after the end of the war. In fact, it was not until 1947 that the situation eased insofar as the securing of equipment and many parts and materials was concerned. It was necessary, therefore, to continue the maintenance work on a makeshift basis during the entire period. Advantage was taken of every expedient in order to render the most necessary services. Materials available for traffic lacquer, for example, were entirely unsatisfactory as compared to prewar specifications and when applied to the road had only about one-third of the life of the prewar lacquer. These factors increased the work of the maintenance forces and added greatly to the cost of the service rendered for various phases of the maintenance work.

Forces Expanded

During the entire war and postwar periods, every effort was made to keep the working force to a minimum. With the return of more normal conditions during the past two years, such efforts have been continued. In January, 1941, as mentioned above, 3,100 men were employed. As of January, 1943, the maintenance field forces consisted of some 2,150 men, including the office staff in the maintenance superintendent's offices. It is expected that by July, 1950, this force will total about 2,400 men. This compares to a normal prewar organization of some 2,500 men. This increase in force, however, does not represent a return to prewar status. It has been a gradual development and made necessary by added functions such as assumption of maintenance of state highway routes in cities in 1948, as authorized by the Legislature, the taking over of maintenance of all highway signs, the increase in number of bridge and grade separation structures, the increase in the number of traffic signals and highway lights and the addition of landscaped areas on freeways, etc., which require continuous concentrated maintenance.

TWO UPPER PHOTOGRAPHS—Snow plows opening highway through Lassen Volcanic Monument. CENTER—"Missouri" type sander for sanding icy pavement. LOWER—Sand shelter for storing sand mixed with salt

Piecemeal Work

The maintenance work, in general, is of a piecemeal and intermittent character that does not lend itself to set times or procedures. It carries with it responsibility for routine patrol of the highways, emergency calls in case of accidents and for special services such as snow removal, etc., which require the continual attendance of a minimum crew. The special advantages of contract work are fully appreciated. It has been possible to keep the crew to a minimum by handling work under contract when the detail can be clearly specified and the time element allows of preparing and advertising a project. As a matter of fact, it would be impossible to keep up the highway surfaces with the present force and equipment except for the 300 to 500 miles of thin surface blankets which are placed each year under contract.

The current program of highway improvement carries with it a need for constant expansion of the maintenance work. The divided highway type of construction not only doubles the mileage of pavement, but also the number of structures, the miles of shoulders and, in general, also the area of right of way to be policed. In addition, of course, there are the grade separation structures on freeways, together with approaches and special facilities. Many of these layouts are elaborate with signals, lighting, etc., and require extensive maintenance. There is also a constant increase in demands throughout the highway system due to increase in traffic volumes, as well as for expansion of special services such as traffic stripes and snow removal. To keep the crew within the present limits under such conditions has required careful planning and close cooperation between the district and headquarters offices. Some of the measures taken are reviewed:

Bridge Repairs and Painting

During the war years work on bridges was limited to the most essential work to keep them in service and preserve the investment. Painting of the bridges was practically ignored during that period. Furthermore, the number of structures in the highway system has increased, as previously mentioned, due to divided highway and freeway construction. It has been necessary, therefore, to increase

the number of men assigned this phase of maintenance. The painting by maintenance forces is confined practically to incidental spot painting and to work on the smaller structures where the cost of advertising would be out of proportion to the total cost of painting guard rail, etc. All major work is handled under contract. This applies particularly to painting work, but the practice is followed, also, where major repairs are necessary if the time element and type of work will allow. A number of bridges that have failed under overloads have been replaced under emergency contract arrangements in a most expeditious and satisfactory manner.

The work of the bridge crews has been expedited and economies made by providing gasoline operated generating plants to operate power tools. Trucks with special bodies for storing and transporting tools and flat rack trucks equipped with winches and hoists to handle heavy timbers are now standard equipment. Pole dollies for hauling long timbers are now furnished these crews.

Snow Removal

The cost of snow removal has increased greatly since the war, as shown by the following tabulation:

Winter season	Direct cost	Total cost (including prorated overhead)
1942-43	$347,007	Overhead charges were not prorated for these five years
1943-44	522,322	
1944-45	474,510	
1945-46		
1946-47	509,737	
1947-48	818,778	$1,040,657
1948-49	1,487,103	$1,774,115
1949-50	1,258,000	Not available at time of writing

The 1949-50 totals shown are estimated, as the cost of opening the mountain passes closed during the winter have not been accumulated at this time. There is little that management can do in the control of cost of snow removal, except to provide the best possible equipment in sufficient amount and see that the supervision is adequate. The work required varies greatly from season to season, depending to some extent on the volume of snowfall, but much more on water content in the snow, air temperatures, wind velocities, spacing of storms and traffic pattern.

The expense of handling removal work for a given storm may be affected considerably in a given area, depending on whether it occurs during a week end period of heavy recreational traffic or during the Monday to Friday period of normal through traffic. It is necessary to organize a minimum standby force at the beginning of a season and to keep such force activated regardless of whether storms are heavy or light. The length of the storm periods is also an unpredictable factor, as overtime of men and equipment increases the cost.

TOP—Trailer-type burner unit used in control of roadside vegetation. NEXT—Tank truck equipped with outrigger for spraying around guard rail and sight posts. NEXT—Showing area sprayed for fire control purposes. BOTTOM—Equipment en route to weed spraying area

Sanding Roads

During the last two years the cost of sanding icy pavement has been on the increase. The principal improvement in this work has been the adoption of the "Missouri" type sander. The total number of sanders in regular service is 75. An additional 21 units have been requested for next season. Of the present total, 48 are of the "Missouri" type. In order to save time in connection with sanding operations, large sand storage bunkers have been constructed at convenient points on several routes such as the Ridge Route in Los Angeles and Kern Counties and at a number of locations in the northern part of the State. Dry sand or sand mixed with calcium chloride is stored in these shelters at the beginning of the season. The shelters are so designed that trucks may be loaded by simply lowering the chute and opening the gate. The sanding operations are thus speeded up, as well as handled more economically.

A major economy on snow removal work is secured in connection with proper timing of start of work in the spring on roads which have been closed during the winter. There is always pressure by chambers of commerce and other interested groups for early start of such work. There is nothing gained by starting such work on a Sierra pass route until the snow has softened sufficiently so that ready progress can be made. Every effort is made to so time this work that the routes will be open at the earliest possible date consistent with economy in the operation.

Traffic Striping and Pavement Markings

On traffic striping work the broken single line adopted during the war years has been continued as standard practice. The use of this broken stripe makes a saving of 110,000 gallons of traffic lacquer in a single year. This represents a saving of $200,000 per year on an average for the last five-year period. Immediately after the war a new traffic striping machine was designed and constructed in the headquarters shop. This machine is believed to be one of the most modern type in service anywhere in the United States. The new machines are so designed that a single stripe, a double stripe, or even two white stripes and a center black stripe may be placed at one time at the will of the operator. Further, a solid stripe and broken stripe may be placed continuously as desired, alternating from right to left. Glass beads are

applied at any desired rate at the same time. These machines permit the application of reflectorized or plain traffic striping at considerable increased speed with resulting savings, of course, in the cost of the work. The specifications for traffic lacquer now conform to prewar standards, and provide better and more long-lasting material than could be secured during the war years. Specifications for beads applied to the stripe have been changed to provide a smaller diameter of beads which will also give a longer life on the road.

Tree Maintenance

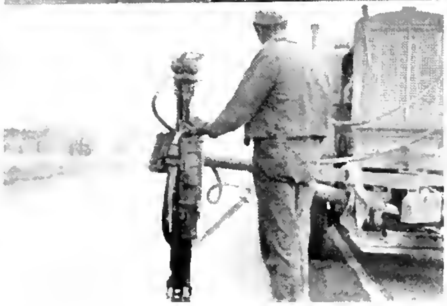
An economy has been secured in the maintenance of roadside trees and shrubs through the use of electrically powered chain saws on tree trimming work, representing a major saving for this item. Flatbed trucks have been acquired also for this type of work. These trucks are fitted with power winches for handling heavy limbs and similar loads. Equipment with telescoping tower is used on tree-trimming operations. This equipment is particularly applicable in the areas in the State where there are considerable numbers of palm trees, as the cutting of the dead fronds from these trees is always a slow and very uncomfortable operation from the operator's point of view when it was necessary to rig lines and work from a swinging platform or rope chair.

Noxious Weed Control

A considerable portion of the annual control of noxious weeds has been delegated to county authorities where the counties were properly equipped and manned to handle the work. Some economy is effected due to the fact that we only pay the actual cost of the work and since their operations also include county roads, we secure whatever benefits result from the increased volume of work. There is also the advantage that state crews are available during the season when most needed for regular maintenance work on the highways.

Erosion Control

It has been found that economy can be made in maintenance of slopes if work is undertaken as soon as small gullies, etc., start to develop, rather than waiting until a major project develops. Such con-



UPPER—Preparing premix surfacing material. NEXT—Reworking pavement surfaces with heavy-duty scarifier and mixer unit. NEXT—Cleaning joints in concrete pavement preparatory to sealing with rubber compound. LOWER—Jig attachment and jackhammer used in drilling holes in concrete pavement preparatory to pumping asphalt for subsealing

trol measures as are taken thus not only keep the slopes in better shape, but reduce the amount of material washed into the ditches which must later be removed. The maintenance of landscaping of freeways, etc., is becoming a major item of work. The upkeep of planting of this type is primarily for appearance' sake, although, of course, there is some benefit from the protection of slopes, etc. There is little opportunity to effect an economy on the work. The watering, mowing, cultivating, etc., must be kept up to a certain standard at all times to be effective. It is found that the cost of maintenance for the first year following the establishing period of plantings of this type sometimes is almost as great as for the original planting. Some savings are effected by the use of chemical weed controls and savings are also made by providing larger power lawn mowers, which the operators are finding they can operate on steeper slopes than formerly, thus eliminating considerable handwork. It is essential that machine methods be used to the greatest possible extent on all this work.

Fire Hazard Control

Commercial compounds are being used largely for work of this type. While there is little saving in the cost of the use of these compounds in comparison to the use of diesel oil, there is saving due to the fact that the necessity of burning the wilted vegetation is eliminated with the compound if applied sufficiently early in the season. The practice has been changed to provide for spraying a six-foot width adjacent to the shoulder. This replaces the nine-foot width formerly sprayed adjacent to the fence lines. The work can be handled more rapidly and a considerable saving results, of course, in material required.

Trailer-type weed burners which were acquired immediately after the war are used where vegetation growth is heavy. These units are equipped with an outrigger arm and designed to carry a burner head through which burning of roadside weeds and other roadside vegetation is carried on from the shoulder line as a continuous operation. Wherever possible, motor graders are used to blade off the vegetation. This type of work, of course, is restricted to suitable localities, as it is not always desirable to disturb root growth. Commercial compounds are being used to sterilize the soil and reduce the amount of vegetation growth in areas where such practices will not result in later erosion damage. These materials are used, also, around sight posts, road signs, guard rails, etc., where hand-control methods were formerly practiced. The equipment used in spraying roadsides has also been improved by an outrigger arrangement which can be more efficiently handled by the operator riding in the seat of the truck.

Subsealing Concrete Pavements

The practices followed in subsealing concrete pavements with asphalt have been improved. An outrigger jig is used to support the jackhammers in drilling holes on such work. The use of this outrigger doubles the number of holes which can be drilled in a day and practically cuts the cost of this item in half. Special asphalt tanks have been constructed at headquarters shop for handling the material and for pumping it under the pavement. These trucks are equipped with burners so that the asphalt can be kept at the proper temperature, and hoses and other appliances are arranged to permit the most ready operation.

In the past four years some $750,000 has been expended on this type of work. It is anticipated that it will be continued for a number of years. The savings made in the more efficient operation will be considerable over a period of time. The original asphalt heating units used in connection with subsealing operations are also used in sealing longitudinal joints on Portland cement concrete pavements where asphaltic materials are used. The use of this equipment represents a considerable advance, as platforms for the men are installed on the rear of this equipment and special nozzles are installed which are adjustable to meet varying conditions so that it is possible to fill longitudinal joints at a speed of two to three miles per hour. Not only is neater work performed with this equipment as compared to former hand methods, but there is a saving of time and economy in this manner of handling the work.

Cleaning and Subsealing of Joints

A good deal of study has been given to the practice to be followed in sealing the construction joints in concrete pavements. Both hot rubber and emulsified latex type asphaltic compounds have been used. Special equipment is required for each of these types. The joints must first be cleaned, which requires special equipment. The maintenance forces have worked with the manufacturers of such equipment, which has resulted in development of very effective units for this type of work. The methods used in applying the filling material have been improved upon over the former practice

UPPER—Tank and heating unit for pumping asphalt used in subsealing concrete pavement. CENTER — Compressor unit and 30-gallon storage tank for asphalt emulsing mounted on 1½-ton maintenance truck. BOTTOM—Heater unit used in heating premix material for patching during cold weather

and the Division of Highways has worked with the producers of material in order to secure the best product for the purpose. While the original cost of sealing joints with the rubberized types of materials is considerably higher than the asphalt compounds previously used, it is expected that the new materials will have a long life which will far offset the first cost.

Routine Maintenance

Many advances have been made in securing the most modern and practical equipment for different phases of maintenance work. The headquarters shop has constructed several asphalt distributing trucks with large capacity pumps, adjustable spreader bars, intercommunication control, and a number of other features which were suggested at conferences between representatives of the maintenance department and the equipment department. During the war years little attention was given to roadsides and on many miles of the highway the growth of brush was encroaching on the roadsides, and in a great many cases presented a hazard to traffic due to the obstruction of visibility.

In 1948 a heavy-duty brush cutter was secured which does a very effective job in cutting the brush and in eliminating a large amount of hand labor. Two of these units are now in service and once the brush cutting work is caught up, the organization will be able to keep the roadsides in good condition with these two units. The ton and one-half trucks used on general maintenance work have been equipped with a 30-gallon tank and air compressor for use in applying emulsified asphalt as a tack coat, etc., in connection with general patching work. These small units are thus always available to the crew and as a result a number of the 190-gallon emulsified asphalt kettles have been retired from service. It is anticipated that a considerable number will ultimately be retired due to more effective use of the tanks on the maintenance trucks. This arrangement will result in real economy in the routine patching work.

Patchwork in Winter

The maintenance organization also worked with the manufacturer in the development of a heater unit for heating premix bituminous materials. Using these units, patches can be made during the winter season in areas along the northwestern coast line of the Redwood Highway and similar locations throughout the State. In previous years it has been necessary to patch breaks in the pavement by placing road rock, which was only a temporary measure. The use of the premix material not only gives a

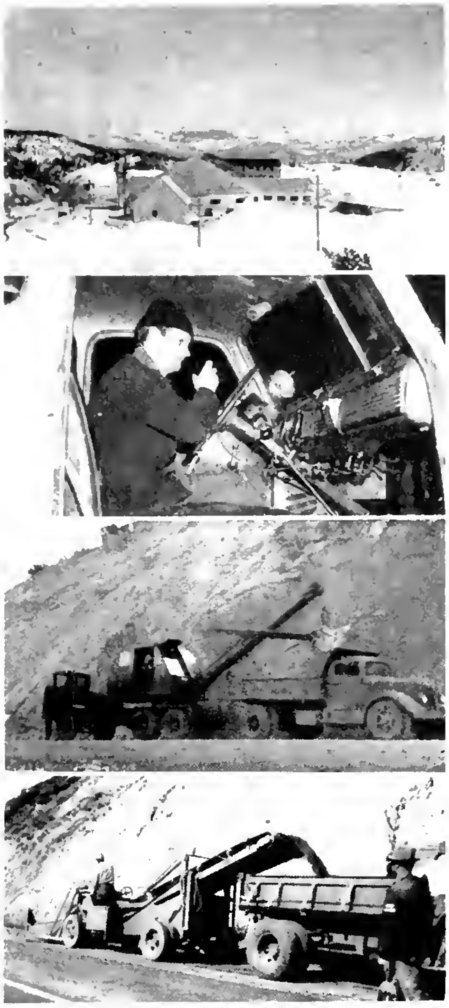
more permanent repair job, but the traveling public is better served.

The handling of materials by hand methods has been largely eliminated by the purchase of front end type loaders. A number of elevator type loaders were secured as soon as possible after the end of the war and such units are used to good advantage where the material can be windrowed by blade and placed in a position to be picked up readily. These units have reduced the time required and the over-all cost of cleaning ditches in several areas of the State, particularly along the Redwood Highway where frequent cleaning of the ditches is necessary due to the heavy rainfall and the character of the material along the roadsides in the cuts.

Heavy Duty Graders

Heavy duty type motor graders with 12-foot blades are now being furnished to all districts. These replace many of the eight-foot type which were in service during the war years. While these units are more expensive, they can handle heavier work and cover any kind of work to advantage. Another benefit is the reduction in the number of tow type graders. These units require a tractor for motive power and the use of two men—one to operate the tractor and the second the tow grader. A considerable number of the tow type graders and tractors have been retired as a result of the extensive use of the heavy duty motor graders.

Another feature developed in the last five years is the shoveling apron which is mounted on the rear of maintenance trucks. With this apron a quantity of material can be released from the body of the truck and carried in the apron. The apron is so mounted as to be convenient for the men spreading screenings and adds considerably to the ease and economy of making bituminous patches or screening sections of seal coat work. In reworking of bituminous surface, two types of equipment—one known as a preparizer and the other the pulvimixer—are used to advantage. The preparizer is a heavy duty scarifier type of machine which does an excellent job of breaking up bituminous surfacing and can also be used in remixing the material after oil has been added. The pulvimixers are smaller units which are not effective in the original breaking up of the surface, but are quite satisfactory units for remixing the material when once broken up. The use of this equipment results in better surfaces as compared to former methods of reworking with motor graders.



UPPER—View of Donner Summit maintenance station showing radio towers. NEXT—Radio telephone installation in truck. NEXT—Truck shovel on slide removal work. LOWER—Power loader picking up spoil from roadside ditches

Signal and Highway Light Maintenance

Special equipment is required for the maintenance of traffic signals and lights along the highways. Ladder trucks are provided which will reach up to a height of some 30 feet and can be rotated to an angle of about 85 degrees. Equipment of this sort is necessary in relamping operations and similar work. The equipment used on the maintenance of traffic signals in the Los Angeles area have two-way radios installed so that the operators may be instructed to cover locations where difficulty has developed. These trucks are provided with special bodies for convenient handling of equipment, storage of tools, etc.

Road Signs

The maintenance of warning and directional signs, which had formerly been handled by forces of the two major automobile clubs, was taken over by the Division of Highways Maintenance Organization early in 1948. This work required the development of special equipment and training of men for the special activity. Some 17 crews are now engaged on this work throughout the State. These crews not only maintain the existing signs, but also install signs on new construction projects as required.

Radio Communication

The radio communication system, which was in service during the war years under special emergency license, is now in process of reconstruction to high frequency type of service. Under the license granted by the Federal Communications Commission System this method of communication can be used for any phase of highway work. An installation has been made in the Eureka district area, as well as the Los Angeles area. The system, which has been in use in the Redding, Marysville, Bishop and San Bernardino districts, is being changed to the high frequency type as rapidly as the men and material are available to carry out the work. This method of communication is very useful in maintenance work, particularly in connection with snow removal and sanding operations. The operators of equipment can get in touch with their headquarters immediately in case of any breakdown or unusual condition on the road. The supervisor is in a position to direct the assignment of equipment to the points where it is most badly needed. He can also order replacement parts or shift the equipment from place to place with the minimum of delay. When the system is completed, as planned, very considerable savings are anticipated in the supervision and actual carrying on of the work. The public will be better protected in case of any road closures or other emergency matters and the routine work can be carried on more economically than is possible without such communication.

Chapter XIX

Materials and Research Department

By T. E. Stanton, Materials and Research Engineer

During the early period of state highway construction in California between 1912 and 1920, preceding the later upsurge (national as well as local) in testing and research, the laboratory force consisted of one testing engineer and one to two assistants.

The work was carried on in a small house or shed at the State Fairgrounds and with very limited equipment.

In 1912, the automotive industry was in its infancy and as a consequence, paved roads outside cities were of limited mileage with a negligible background of experience on which to base performance predictions.

The approximate total motor vehicle registration in California in 1907 is reported to have been 10,020 and still less than 100,000 when state highway work was started in 1912. By 1914, the truck count was only 6,156 with no heavy trucks of today's standards. By 1920, the total motor vehicle count had reached 540,000 of which 32,555 were recorded as being trucks of all classifications with not over 2 percent or 10,000 being of five tons or over.

Serious Situation

It is obvious therefore, that the standards of construction of 1912 to accommodate less than 100,000 relatively light-weight motor vehicles were grossly inadequate to accommodate the traffic of only eight years later and that with a six-fold increase in truck traffic, the light pavements constructed during that period had shown serious distress long before 1920.

In fact, so serious had the situation become by 1919, that in 1920 the Bureau of Public Roads at the request of the California Highway Commission, made a study to determine the true condition of the roads built and, as far as possible, the causes of the existing conditions.

The bureau report on the California Survey was made in 1920.

The following year (1921), the California State Automobile Association and the Automobile Club of Southern California, published a joint engineering report on the California State Highways in which it was strongly recommended that the Highway Commission set aside a budget of sufficient funds for the continuous study of special problems including soils and subgrades, pavements and the effects of traffic.

Program Launched

The report commented that:

"These and other tests suggested by modern practice should be programmed. They would be expensive, would take time and would require a specially trained staff of assistants, but the magnitude of the work justifies such expenditures and would teach the commission and its engineers how to avoid otherwise costly mistakes."

Whether as a result of the above investigations, reports and recommendations, or as a logical development of the experience of previous years, it is a fact that shortly thereafter the State Highway Department started a program of testing, research and development which was continued unabated through subsequent years and which has kept pace with the increasing volume of traffic and the increased design, construction and maintenance problems.

The State Legislature of 1921, set up the Department of Public Works and included the State Highway Department therein. Immediately thereafter, all testing including the work of the Chemistry Department, which had up to that time been operating as an adjunct of the State Purchasing Agent, was placed under the jurisdiction of the Director of Public Works who, in turn, assigned the work to the Division of Highways.

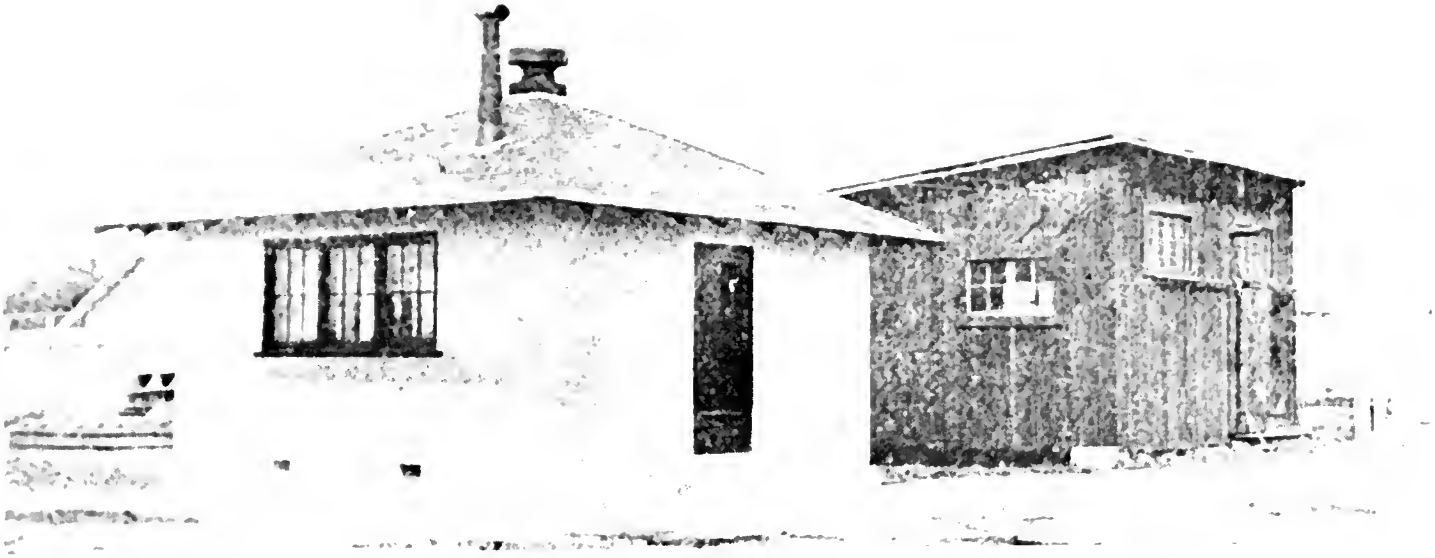
Laboratory Established

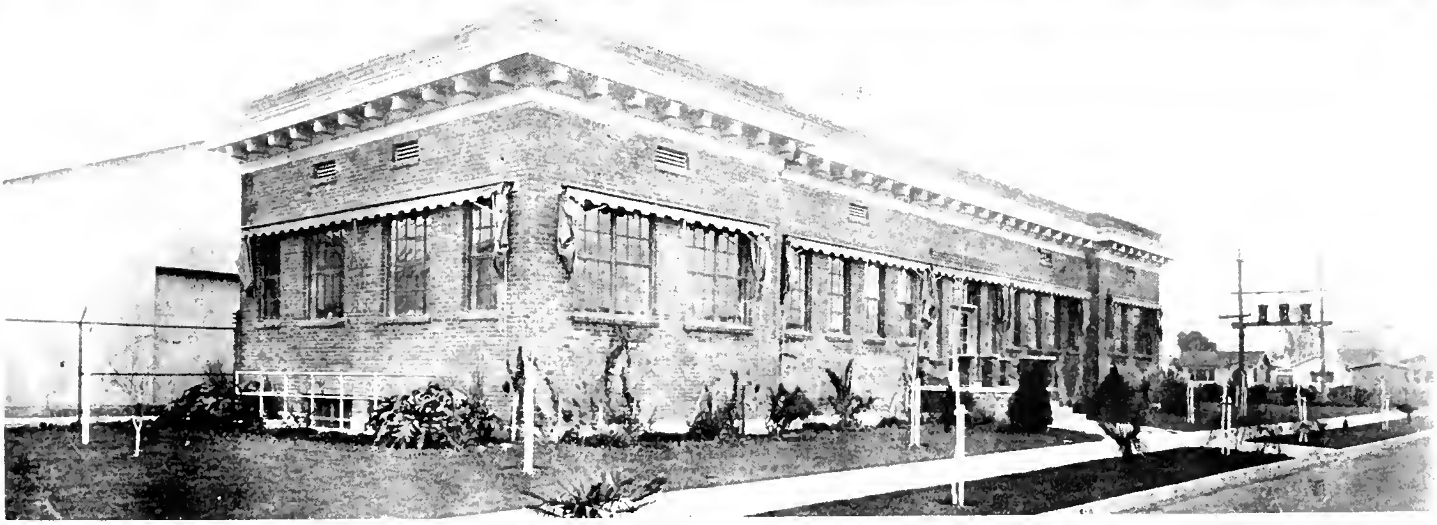
To handle the increased volume of work, the California Highway Commission authorized the erection and equipment of a building to be known as the Testing and Research Laboratory.

The structure erected was a Class A building of brick, one story in height and covering an area of 3,465 square feet. Today, after nearly 30 years, this building still constitutes the main administrative part of the department, although expanding activities over the period of years have required ten-fold expansion of operating area. This requirement has been met by adding wings at each end of the old brick building for a total length of 80 feet and excavating a basement under the entire area for a total area of approximately 11,000 square feet. In addition, the operations have been expanded into corrugated metal warehouse areas outside the main building, approximately 25,000 square feet, or a total of 36,000 square feet.

All current operations are under cramped conditions in buildings built to accommodate only a fractional amount of the work now carried on. Hedged in by the Equipment Department requirements, there is no room for further expansion of the laboratory at its present site. This condition has been the motive behind a movement for a new laboratory to be built on a 10-acre site at Folsom Boulevard and 59th Street, purchased in 1946 in anticipation of an enlarged program of testing and research under the expanded highway program.

It is expected that the new structure will be built within the next two years; construction to start as soon as the Division of Architecture can complete the plans and funds become available.





TOP—Laboratory facilities of Highway Department during period 1912-1921—located on State Fair Grounds. CENTER—Laboratory Building constructed at 34th and Serra Way in Sacramento in 1921. BOTTOM—Laboratory at same location, enlarged in 1933

The new building will provide approximately 60,000 square feet of working area, sufficient it is hoped, to accommodate any forseeable future requirements, and will probably cost in excess of one and one-quarter million dollars.

Research

Among the outstanding phenomena of the second quarter of the Twentieth Century, has been the development and expansion of the research activities of private and public agencies in an effort to produce either more durable products or new products to satisfy the insistent demands of the public.

Webster defines "Research" as:

1. A searching for something, especially with care and diligence.
2. Careful or critical inquiry or examination in seeking facts or principles; diligent investigation in order to ascertain something.

"Research" is elsewhere further defined as:

> Critical and exhaustive investigation or experimentation having for its aim the discovery of new facts and their correct interpretation, the revision of accepted conclusions or the practical application of such new or revised conclusions.

By these definitions, it will be noted that by the term "Research" we do not mean merely searching in the ordinary sense of the word, but searching again and again—researching critically, exhaustively, until the goal of new facts, correct interpretations, right conclusions, or practical applications are attained.

What Research Involves

We speak of research as being "pure" or "applied." By "Pure Research" we usually mean the seeking after new knowledge principally for knowledge's sake. "Applied Research" on the other hand, connotes the desire to acquire knowledge in order that it may be applied in some practical way, such as increasing the serviceable life of highways, eliminating traffic hazards, or producing equally durable pavements and structures at lower cost. To be specific, the field of "Applied Research" as it relates to highway design, construction and maintenance involves studies and tests not only to determine the quality of rock, sand, cement, road oils, asphalts, steel, timber, paints and all of the other types of materials which may on occasion enter into state highway construction, but likewise the proper combining of these components to produce the most durable and serviceable combination attainable with the materials economically available.

In addition, research may involve studies relating to the type and positioning of warning and traffic guide devices and constructions to reduce traffic hazards to a minimum.

The Advisory Board on Highway Research of the National Research Council was formed November 11, 1920, to assist in outlining a comprehensive national program of highway research and coordinating activities thereunder with a membership consisting of:

> Those organizations of national importance interested in design, construction, economic maintenance and financing of highways; in materials and equipment therefor and in vehicles used on highways; governmental departments and bureaus of similar interests, the higher educational institutions * * *.

Bureau of Public Roads

California has always taken active part in the work of the board and the head of the Materials and Research Department has throughout the years been the official state contact member.

In May, 1918, the Federal Office of Public Roads and Rural Engineering started publication of the magazine *Public Roads.* Within two months, the "Office of Public Roads and Rural Engineering" became the "Bureau of Public Roads" but the official publication of that agency continued under the title, *Public Roads* until December, 1921, when publication was temporarily suspended under what is understood was a ruling that the Bureau of Public Roads was not authorized to issue a journal relating to highway construction, as such.

In March, 1924, publication was resumed under a ruling that the department was authorized to engage in research activities and to publish the results of any research conducted.

Nation-wide Research

The title now became *Public Roads —A Journal of Highway Research,* which title has persisted to the present date and during the intervening years the bureau has actively engaged in research not only on its own account in Arlington, Virginia, and elsewhere, but likewise nation-wide in cooperation with the different state highway departments, universities, and the Highway Research Board.

During the same period, industry engaged in the production of road building materials came to a realization that their interests were vitally affected and that it behooved them to promote quality in their products. As a result, research agencies gradually came into existence representing all materials interests, including the bituminous, Portland cement, aggregate, steel, timber, and paint industries operating in cooperation with nonindustrial technical associations in the different fields, including the universities and state highway departments.

Outstanding Laboratory

The California Division of Highways has available one of the greatest field laboratories in existence in the thousands of miles of state highways which in their construction and traffic control have involved the use of all classes of materials and combinations thereof.

It has, from the start, been the practice of the Materials and Research Department to not only make laboratory quality tests of all materials entering into highway construction, but to likewise continuously study the performance of these materials in actual construction to the end that advantage may be taken of the lessons learned from bad or inferior performance, to so improve the standards as to secure longer life and lower maintenance costs. In this field, the knowledge of the department extends over a period of almost 40 years and, up to the present time at least, not only has there been available the opportunity to observe and study performance history throughout that period, but there has been available for the purpose engineering personnel associated with the department throughout most, if not all, of the period and, therefore, thoroughly conversant with the problems involved.

Progress in Highway Design

It has been the practice of the department to constantly study the performance not only of the California state highway construction, but likewise the performance of construction under other

Testing and Research Laboratory as it looks today

jurisdictions; city, county, state, federal and even world-wide.

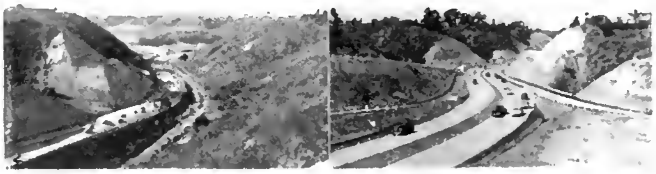
The result has been a gradual improvement in the performance and lasting quality of California state highways and the development of design standards not only leading to greater durability but likewise regulating and facilitating the flow of traffic and the guidance of this traffic so as to minimize traffic hazards.

This control has cost millions of dollars but it is the considered opinion that these millions have not only been well spent but that unsolved problems both new and old which still plague highway engineers justify the continued expenditure of hundreds of thousands of dollars annually not only in the testing of materials but likewise in the development of new standards of design, construction, maintenance and traffic regulation.

The value of the work of the department is best attested by others not connected with the organization as evidenced by the following national awards:

1. **The Wason Research Medal, by the American Concrete Institute in 1938, for a report on studies on "The Resistance of Cement to Attack by Sea Water and by Alkali Soils."**
2. **The Norman Medal, the highest award of the American Society of Civil Engineers, awarded in 1943, for a report on new discoveries of an outstanding nature.**
3. **National Highway Research Board Award in 1949, for an outstanding paper on factors underlying the rational design of pavements.**

In addition to the above, national technical literature is replete with reports on research conducted by the department in all fields of highway design, construction, maintenance and operation.



Chapter XX

The Equipment Department

By E. E. Sorenson, Equipment Engineer

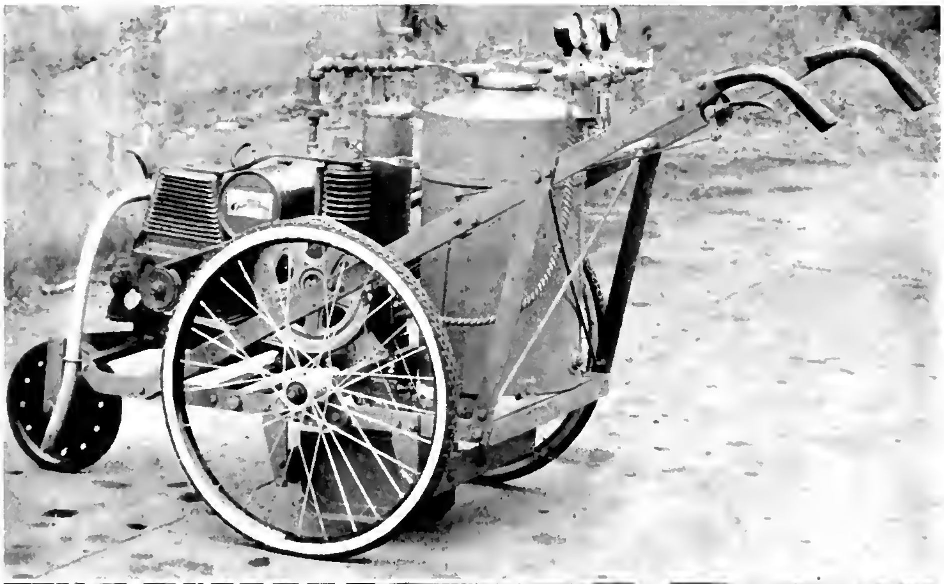
In the early days of the California Highway Commission, which on August 8, 1911, had been given a separate status from the then controlling State's engineering organization, very little need was felt for an Equipment Department; in fact, up to about the beginning of the first World War, the then Highway Engineer initiated and personally directed the purchase of, also oversaw the functioning of, the very few especially designed labor saving devices that were employed.

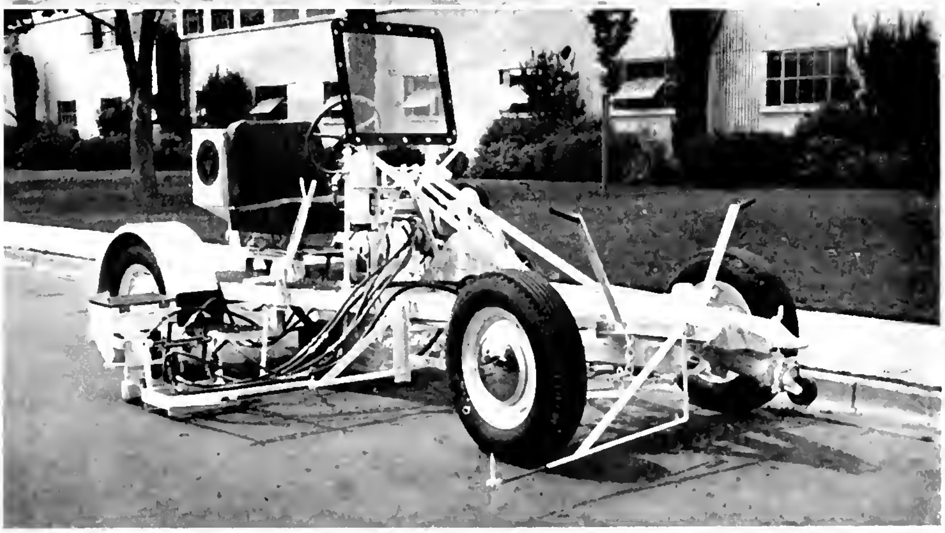
For much of the time during this period, many of the roads were constructed by handwork, the nearest approach to anything mechanical being horse drawn scrapers, plows, etc., and thereafter the roads were maintained by using the same machines and methods employed in their construction.

Early Day Equipment

With the exception of trucks, the following was about the extent of equipment especially designed for roadwork: pull graders and dump wagons (both for which horses usually furnished the motive power), occasional steam operated power shovels sometime using coal or wood for fuel, a few gas engines, pumps, and three-wheel steam propelled rollers. The same units, with the addition, at times, of timbered drags, were usually the limit of any labor saving devices used on road maintenance.

Until about 1919 the use of any late developments in the construction of roads for the then existing Highway Commission was initiated solely by the Highway Engineer. It was his custom to religiously keep abreast of the fast developing field of especially built equipment that might be adapted for use in road construction. Whenever any new device was announced in the current magazines or engineering pamphlets which he considered suitable, he would cut out the announcement, attach it to one of the then famous "Blue Backs," and, together with some comment as to its probable suitability, etc., for road building, would send it direct to the highway commissioners for comments. Provided their reply was favorable, the great venture of going into an untried field was taken as soon as the equipment could be bought.





UPPER—Highway striping machine in 1933. LOWER—Striping machine, 1948

Army Surplus

As a consequence of much United States Army surplus, resulting from termination of the first World War, the

government disposed of quantities of excess machinery, equipment and materials, all supposed to be adaptable to road building purposes. This surplus was offered to the states, the expense for its acquisition by them being, in most instances, the cost of handling and transportation from point of government's storage to point of the State's use. California's share of this windfall was expected to be various types of road construction equipment, but actually consisted mostly of trucks, although some shop equipment, truck parts, hand tools, pull graders, engines, and pumps with pipes also blasting powder were secured.

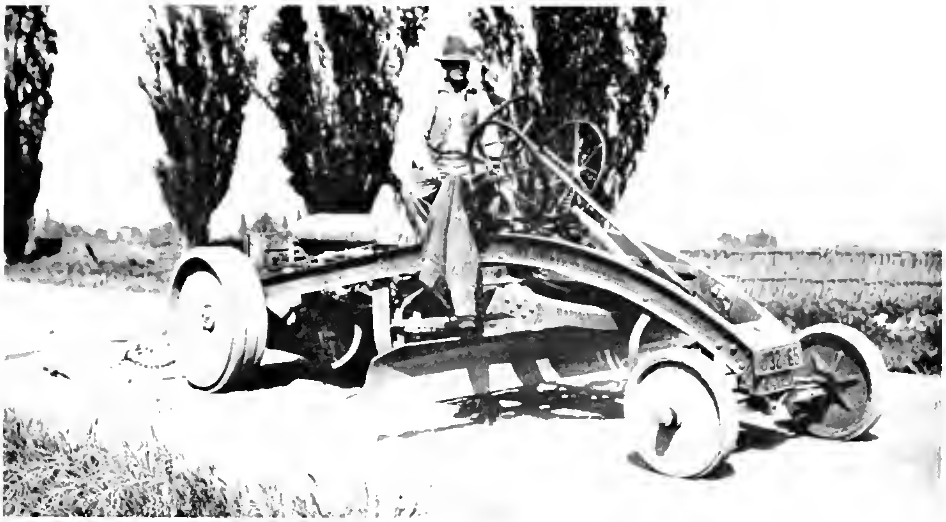
Much of the former government-owned road equipment and materials, allotted this State and said to have cost nearly 4½ million dollars, proved to be not well suited for the purpose intended, or was in poor condition, however its use brought into sharp focus the ease, savings in time, and better results obtained through using machine, rather than hand method, for road building.

Department Organized in 1919

Beginning around 1919 the Equipment Department, as it is now known, was organized, its first function being to select and oversee the acquisition of the State's fair proportion of war surplus equipment. However, as California, unfortunately, was about the farthest removed of all the participating states, and at the time also possessed a population ranking among the lowest, in many instances it was allotted equipment which had been passed over by other states; and this notwithstanding the fact that acceptable units had been selected, specifically designated by qualified personnel and promised for shipment.

During the period following the organization of the Equipment Department, and up to about 1924, the control of all major construction and maintenance equipment in districts, then termed "divisions," was vested entirely in the District Engineer, the Highway Equipment Engineer exercising only a part in its distribution, maintenance and repair.

The State Highway Engineer had by this time become thoroughly convinced that a more centralized control would result in minimizing the natural tendency of districts to hold on to equipment that had become a financial drain upon them.



UPPER—One-man motor grader used in 1926—tractor can be separated from grader attachment. LOWER—Adams motor grader working near Petaluma in January, 1942

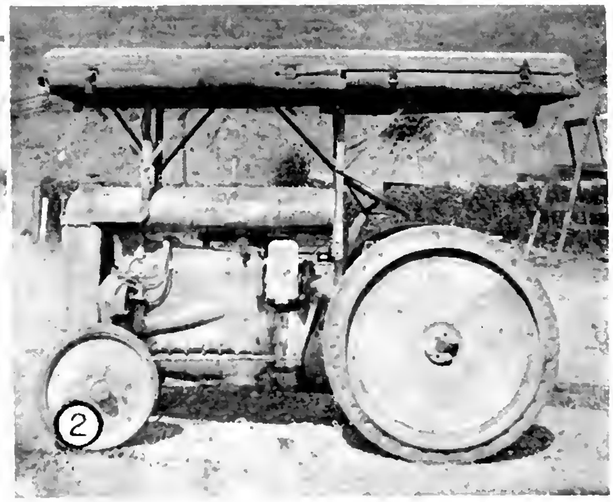
Therefore, it was decided that the newly organized Equipment Department should exercise control over all major highway construction and maintenance units (those assigned a CHC number); also that the department should act in a consultative capacity, passing on the advisability of purchasing any additional equipment asked for by a district.

Separate Equipment Fund

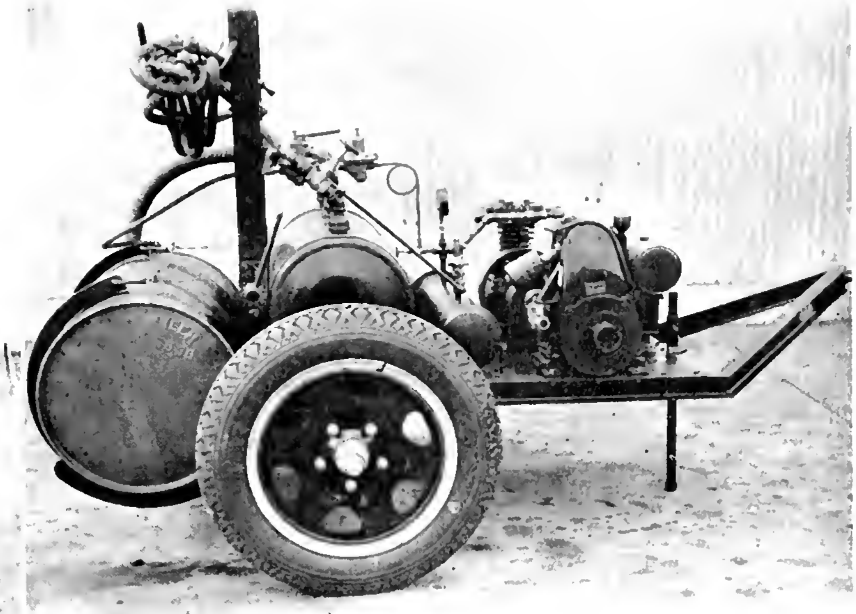
It was also decided that all future purchases and repairs should be financed solely from a fund secured through charging all those using equipment, a fixed rental, which would be uniform to each type. In other words, the Equipment Department would own all major equipment and secure its entire revenue for a unit's replacement, current maintenance and administration, from rentals alone, each rental to cover furnishing of a "bare unit" only—without operating labor. All replacements were to be made whenever the unit in question was found to be uneconomical for continuance in service.

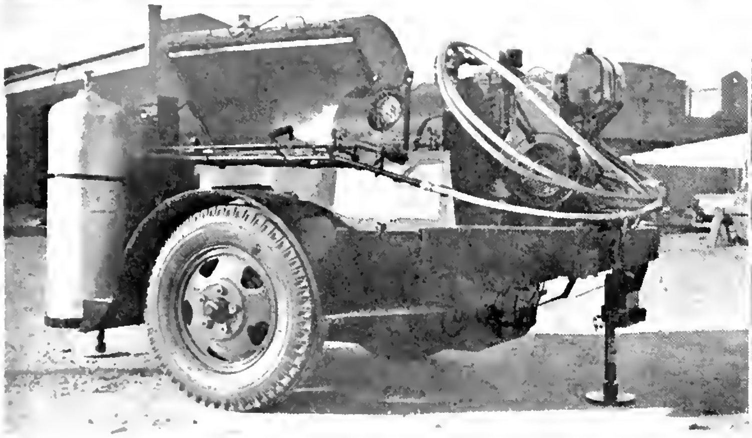
A physical inventory taken as of June 30, 1926, and accounted as of September, 1926, developed that the department had

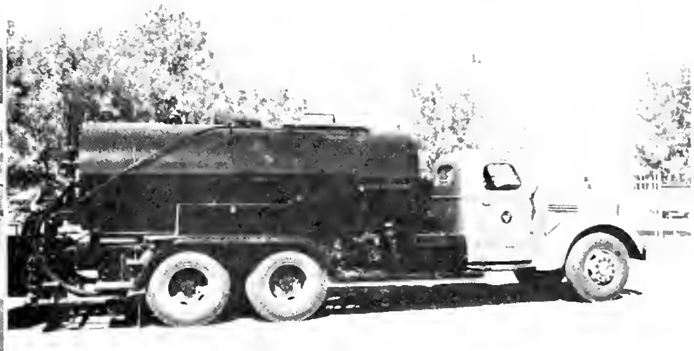
①



1—Fordson & Monroe adjustable superior 13-foot two-way road drag, 1924. 2—Fordson tractor with canopy top, an old timer. 3—Three-mule team hauling sand being helped out of bog in early day highway building. 4—Caterpillar tractor pulling Austin-Western scarifier, 1913. 5—Fordson iron mule used on highway construction in Plumas County, 1933-35. 6—Buffalo-Pitts steam roller, 1913







UPPER LEFT—Oiling by 600-gallon, horse-drawn distributor, Fresno County, 1913. LOWER RIGHT—Modern oil distributor, 1,850-gallon capacity. UPPER RIGHT—Emulsified power asphalt kettle, 1937. LOWER LEFT—Modern 165-gallon asphalt kettle

a total of $3,259,649.88 in equipment, that amount being divided into $2,077,679.31 of automotive and $1,181,970.57 in construction units.

Theoretically, the rental applicable to any unit is fixed just high enough to insure its returning sufficient revenue to care for its upkeep, depreciation and administration. However, such a condition can only apply to the whole, as in regard to each unit, unknown and unforseeable factors may result in it returning revenue greater, or less, than that figured on for the average.

Rental System

The existing rental system is flexible and can always be adjusted to meet special conditions; it definitely serves to hold the capital investment to a minimum, also eliminates the natural tendency of districts to hold on too long to equipment for possible future needs.

The system employed to collect each unit's rental is by the use of a monthly equipment pay roll, on which all units assigned to a district are shown. This information is required each month, together with proper notations as to whether units are in use, and if so the number of shifts, etc., of use; whether they are laid up for repairs, or idle in the field. Such a report allows for a continual check to be made on a unit's condition and operation. The system also reveals any surplus of units that may exist in a district, thereby permitting needs for similar equipment in another district to be filled through a transfer.

District Shops

Each district shop, also all rental equipment located in the various districts, is directly controlled by a superintendent of equipment, who has under him a force of productive as well as clerical help. He also has the proper facilities for making all necessary repairs to the units under his supervision. In the event he lacks equipment for doing unusual repairs—permission is always obtainable to have them done in some local, outside shop. Forms incidental to maintaining correct records for each unit are accurately kept.

An excellent feature resulting from the above type of control is the spirit of competition that it engenders; this spirit has been heightened through furnishing

each of the 11 district equipment superintendents, also the party in charge of mechanical equipment on the San Francisco Oakland Bay Bridge, with a comparative quarterly statement which shows the results of his department's operation.

From early in its organization, the department has furnished much major equipment to prison camps that are located in isolated sections of the State. These camps were established for the dual purpose of relieving congested conditions in the State's prisons, and for the supplying of labor for road work being done in sections where the obtaining of free man labor would be difficult.

Beginning with the fiscal year commencing 1948, the Equipment Department assumed control of all major equipment that had been previously required for maintenance work of the San Francisco Oakland Bay Bridge. This equipment is now being operated on the same basis as that in all districts, and, with few exceptions, necessary repairs are made at its own shop.

Buildings and Floor Space

In order to furnish proper housing, both for repair and shelter for those units that may be temporarily idle, the Equipment Department has built adequate facilities at strategic points in each of the districts throughout the State. Isolated sections which are not readily accessible, such as prison camps, etc., are also furnished with the necessary tools and facilities to allow for prompt repairs being made to all equipment used at such points.

As of June 30, 1949, the total area of floor space available at headquarters and at the various districts amounted to 228,835 square feet. Since that time, because of an expanded highway program, which necessitated greater facilities for both repairs and shelter, one building containing 12,000 square feet of floor space, and to be used as a truck repair shop, has been built at Headquarters Shop in Sacramento. Also, additions to, and improvements to existing shop facilities at other points, which approximate 50,000 square feet, are now in the course of being designed and constructed.

Rental of Outside Equipment

Because it would be out of the question, as well as financially unsound, to constantly maintain extra units of equipment from which the needs for special jobs could be supplied, it has long been the highway's custom to "rent" some construction units from outside sources. These units are usually completely manned and fueled, and require their upkeep to be cared for by the owner. Before such equipment is secured, the want is always checked against a list of state-owned equipment that, at the time, might be available for transfer. Incidentally, it has sometimes been found that while similar highway-owned equipment may be available for transfer, the short period of the need, plus costs incidental thereto, is found not to warrant its transfer.

Changes in Methods

During the last 18 months, a number of changes in the methods previously used by the Equipment Department have been brought about.

Adequate office facilities have been constructed and are now being occupied. Various departments have been shifted around in the interests of more economical operation, and a new truck repair building has been added to alleviate the crowded conditions in the heavy equipment department.

A standardization committee has been working on improvements to certain equipment or parts that are in frequent use. As the Equipment Department has over 5,300 separate pieces, representing a capital investment of over $14,000,000, with approximately 200 pieces having very similar attachments, such an accomplishment would be very desirable for the Highway Department. But it should be kept in mind that many makers of construction equipment who are involved, question the change as being of general value—as it could not apply to equipment serving parts of the country having widely different requirements.

This standardization procedure is slow and will, unquestionably, require some time to bring about the desired results.

Repairs to Other State Equipment

Although the various types of equipment, purchased for special purposes, frequently require alterations in order to better meet the needs of the department, it continues to be the policy of the department to secure such equipment by purchasing in the open market rather than by constructing it in its Equipment Department shops.

So far, most makers of standard equipment have been found very receptive to suggestions which lead to improvements or modifications of their units, so that they may better fit the State's needs or comply with some indicated need developed through actual use.

In furtherance of the task of decreasing the State's general operating costs, facilities of the Equipment Department are increasingly being called on to

Materials and Research Soil Testing Drill Rig Built at Sacramento Highway Shops

Two views of the present Division of Highways Shops in Sacramento

render urgent repairs to equipment of other state departments which may have broken down, or become decommissioned, near a Highway Department's already existing repair shop. The use of these shops invariably does away with the necessity for the long "dead" hauls necessary in returning the broken-down unit to the point where repairs are usually made.

Personnel

Headquarters Equipment Department and Headquarters Shop employ a total of approximately 160 at their plant, located at 34th Street and Stockton Boulevard, Sacramento.

The district shops, and other outlying shops, employ approximately 400, making a total of approximately 560 in the Equipment Department.

The only employee still working who is personally acquainted with the entire history of the Equipment Department is Major William J. Gough, Assistant Equipment Engineer. He was assigned to the department in 1919, at about the time a large quantity of World War I equipment was received, and has been continuously in a supervisory capacity since that time. This article was prepared under his supervision, and from his large stock of personal information.

When the Equipment Department was organized in August, 1921, R. H. Stalnaker, who entered the service of the Division of Highways in 1911 and who retired on January 1, 1949, was placed in charge as Equipment Engineer and served continuously in that capacity until his retirement. He set up the equipment rental system in January, 1924.

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director* — GEORGE T. McCOY, *State Highway Engineer*

KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*
MERRITT R. NICKERSON, *Chief, Photographic Section*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to
CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499, Sacramento, California

Vol. 29 — Nos. 9, 10

printed in CALIFORNIA STATE PRINTING OFFICE 25869 4-50 28M

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL
Director

GEORGE T. McCOY
State Highway Engineer

KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 29 November-December Nos. 11, 12

Public Works Building
Twelfth and N Streets
Sacramento

CONTENTS

MANY THANKS

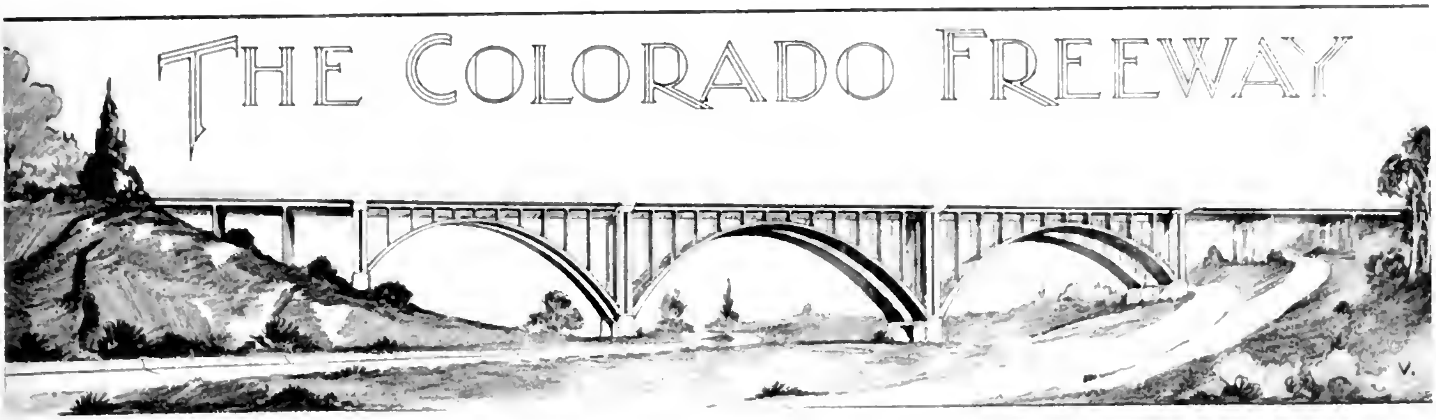
CALIFORNIA HIGHWAYS AND PUBLIC WORKS deeply appreciates the many hundreds of letters and postcards complimenting the Department of Public Works on the publication of the Centennial Edition.

The editors of the magazine would like very much to have answered all these communications personally, but the volume of the letters received made this impossible.

Our sincere thanks to all those who took the time to write in.

Editor

THE COLORADO FREEWAY



BRIDGE OVER ARROYO SECO

By HARRISON R. BAKER
Highway Commissioner

THE NEW Arroyo Seco Bridge on the Colorado Freeway in Pasadena is destined to have the longest concrete span of any bridge ever built in Southern California. This structure, to be built alongside the famous Colorado Street Bridge in Pasadena, will consist essentially of three long concrete arch spans —230 feet, 319 feet, and 230 feet. These arches, detail plans of which are now being drawn, will rank among the longest of their type in the western United States.

Especially designed to harmonize with the architectural features of the existing bridge and to enhance the natural beauty of a site already famed for its picturesque and parklike setting, the new Arroyo Seco Bridge will be a structure in which the residents of Pasadena may justly take pride.

Will Relieve Traffic Jam

However, the new structure will be noteworthy not only for its imposing appearance, but also for the relief it will afford to what has become an intolerable traffic congestion situation. Furthermore, it is expected to be the first link of the new six-lane Colorado Freeway, an arterial highway which it is anticipated will ultimately be the main east-west route through the northerly portion of the Los Angeles metropolitan area. The bridge, construction on which is expected to start early in 1951, together with its approaches, is expected to cost in the neighborhood of $3,500,000, which will make it the most costly nontoll highway structure ever built in California.

Important Highway Link

The proposed Colorado Freeway is expected to be one of the most important links in the Southern California highway system. It will connect U. S. Highways 99 and 101 on the west and north with U. S. Highway 66 on the east, and thereby serve as a by-pass around downtown Los Angeles. It will also carry heavy local traffic between the Cities of Burbank, Glendale, Pasadena, and the foothill cities extending on the east to San Bernardino. Except for the inadequate road crossing the Devil's Gate Dam there is no traffic artery between the communities on the east and west sides of the Arroyo Seco in this vicinity.

FRAGMENT

The existing Colorado Street Bridge was built in 1912 and 1913. When it was completed, there were about 35,000 automobiles in all of Los Angeles County; in 1949 the county's total motor vehicle registration exceeded 1,800,000. Small wonder that it is inadequate for present-day traffic.

Plan New Bridge

The old bridge was added to the State Highway System in 1933. Shortly thereafter, an extensive investigation of the existing structure was undertaken to determine the best method of increasing the traffic capacity, since the bridge by that time was already a cause of acute traffic congestion. As a result of the investigation, it was proposed at that time that a parallel bridge duplicating the existing structure be constructed. But this proposal met with such a storm of protest in the newspapers that the entire project became dormant and remained so until funds made available by the Collier-Burns Act made it possible to plan for the new bridge.

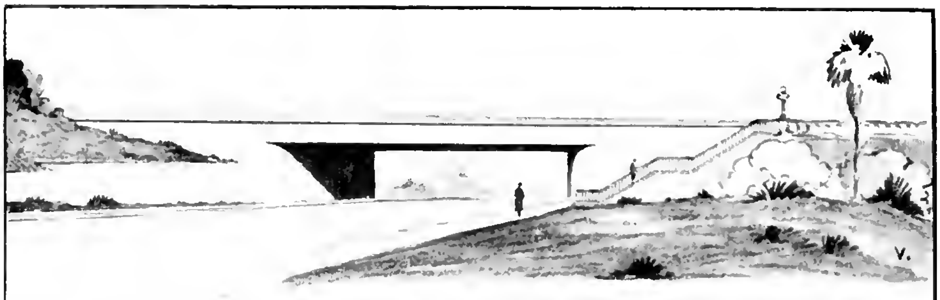
Architectural and engineering studies of various types of bridges adaptable to the site were then undertaken. After all factors of economy, aesthetics, and local preference were weighed it became apparent that the

chosen type was best suited to this difficult crossing.

Design of Bridge

The total length of the new bridge will be 1,366 feet—more than a quarter of a mile. The three main arch spans, in the central portion of the structure, will have concrete box girder viaduct approaches at each end. The easterly approach viaduct will be 215 feet long, and the westerly viaduct 372 feet long. The maximum height of the structure from the ground to the deck will be 130 feet. Each of the two three-lane roadways will be 40 feet wide, and they will be separated by an eight-foot-wide dividing strip. The total width of the bridge will flare out from a width of 94 feet at the west end to a width of 168 feet at the east end.

The existing two-lane Colorado Street Bridge is one of the most severe traffic bottlenecks in the Los Angeles area, carrying over 20,000 vehicles per day. The narrow roadway width together with the sharp reverse curves on this structure frequently cause jams which back up traffic at both ends for many blocks. This critical traffic congestion will be alleviated by the construction of the new freeway, for the latter is being designed to carry an average daily traffic load of some 31,000 vehicles, with a peak hourly traffic capacity of 3,100 vehicles. After the completion of the freeway, the beautiful Colorado Street Bridge, one of Pasadena's most treasured landmarks, can continue to serve local traffic, estimated at 1,800 vehicles per day.


LINDA VISTA AVENUE

Freeway Location

The Colorado Freeway location is approximately one block north of Colorado Street at the Pasadena side of Arroyo Seco, and joins it at the westerly end. The major portion of the new bridge will be about 400 feet north of the old structure. The existing bridge will carry two-way traffic as a frontage road with connections to Grand Avenue and to Orange Grove Avenue via Green Street. The westerly approach of the old bridge will be rebuilt on a curved alignment to connect with the frontage road and to provide an undercrossing for the Linda Vista Avenue off-ramp of the freeway.

The layout of the bridge and its approaches is complicated by several unusual problems. The westerly end of the bridge is on a 2,000-foot radius curve, which requires that many supporting structural members of the bridge be constructed on curved lines. The Linda Vista Avenue off-ramp crosses under the bridge at a sharp angle, requiring a unique triangular bent to preserve the pleasing appearance of the structure. Minor relocations of El Circulo Drive, Arroyo Drive, and Arroyo Boulevard will be required to accommodate the bent columns and piers adjacent to these streets.

. . . Continued on page 19

This is a scale model of the proposed Colorado Street Bridge (left) alongside the existing structure at right

Tioga Pass

Cement-Treated Base Successful at 10,000 Feet Elevation

By S. LEWIS ROHRER, District Materials Engineer

Tioga pass (IX-Mno-40-A) is the highest pass over the Sierra Nevada Mountains in the State Highway System, reaching an elevation of nearly 10,000 feet. It is the eastern approach to Yosemite National Park, as well as having high scenic value in itself, passing beside Lake Ellery and Lake Tioga. Both of these lakes, and other lakes and streams in the vicinity, offer excellent fishing in the summer and a good deer hunting area in the fall.

The greater part of the traffic is composed of vacationists taking advantage of both these recreational facilities and the proximity of Yosemite National Park. It is also considered by many of the automobile clubs of the eastern states as being a more direct and scenic route for their members coming via U. S. Highway 6 to Benton Station and then across to the Central Valley and San Francisco via Yosemite National Park. It passes within a mile of the old town of Tioga which had a number of producing mines in the latter part of the nineteenth century. At the present time these mines are not in operation. The only operating mine in the immediate area is at Saddlebag Lake about five miles from the eastern end of the project.

UPPER—Yosemite National Park looking east on old road, 1947. LOWER—1950, showing new road after two winters. Looking west to Yosemite National Park Gate

Spongy Roadbed

In 1947, the existing graded earth road with a light bituminous surface treatment had reached a stage where traffic safety was jeopardized by reason of the spongy roadbed from the top of the pass, Yosemite National Park Gate, to 2.5 miles east. At that time it was decided to reinforce the base and cover with plant-mixed surfacing. Bids were opened June 5, 1948, but due to the fact that only a single bid was received, and that greatly in excess of the engineer's estimate, the bid was rejected. It was then decided to cement-treat the subgrade and pave with road-mixed surfacing, using state forces on a day labor basis.

The entire 2.5 mile area was affected by springs and seeps, and the melting snow presented an extra problem due to the fact that the road is not opened until the National Park Service opens the remaining portion of the road through the park in the latter part of June. This allows a long period, possibly several months, for the snows on the roadway to thaw and freeze at night. It was hoped that the cement-treating of the subgrade, in connection with drainage improvement, might obviate these factors.

Imported Material

The material in place on the road averaged about 17 percent passing the number 200 mesh sieve. Headquarters Laboratory preferred to cement-treat material with about 12 percent passing the 200 mesh sieve. This necessitated

UPPER—Looking east from Station 22 showing where failure occurred during construction. Taken July, 1950 after two winters. LOWER—Looking east from Station 28 showing where failure occurred during construction. Taken July, 1950 after two winters

liminary and construction tests, showed satisfactory results, even though the surcharge was not then in use on the California Bearing Ratio. This material when tested in 1947, despite the fact that it had definitely failed, still showed satisfactory test results, including plasticity index. The only available clue to the failure in the material itself was the fact that cementing value tests showed a decided slump when the forms were removed.

National Park Cooperates

At the time of the original construction in 1940, a thorough search was made in the vicinity of the project to find the best material available locally. All of the material was either glacial moraine or material derived from glacial moraines, all of which showed a high percentage passing the 200 mesh sieve, and with relatively high percentage of silt and very little clay.

In 1947, through the courtesy of the National Park Service, the search was extended within the park boundaries and three possible material sites were located, one of which was too close to the National Park Highway and therefore discarded. Of the other two, one had only a limited amount of material and was in a hummock (monadnock) at the lower end of a meadow about 1½ miles west of the project. This material was similar to DG and was used until the small quantity available was exhausted. The final pit, which

importing material in order to lower the passing 200. The National Park Service allowed the district forces to enter the park and obtain material superior to anything to be found outside. It was intended to scarify three inches of the roadbed and to import sufficient material to cement-treat six inches and thus bring the passing 200 within the specified range. In the course of construction it was found that in much of the project it was only necessary to import about 25 percent of the material and still stay within the grading range.

The original material, placed in 1940, was taken from a pit on the Saddlebag Lake Road near the eastern end of the project. This material, on both pre-

Looking east from Station 20 showing melting snow condition, July 1950

Looking east from Station 74 showing snow condition, July 1950

coarser imported material and cement treating, as well as drainage correction, would eliminate this flow.

Hard Hauls

Tests showed a psi of about 200 for 4 percent cement, and 250 psi for 5 percent. It had been hoped to obtain 500 psi but this was economically impossible. Due to the steep adverse grade and numerous short radius curves all trucks and trailers bringing materials had to be bob-tailed at the foot of the hill near Leevining. This meant double handling of the cement and it was therefore decided to use 4 percent cement with a minimum of 175 psi.

At a 10,000 foot elevation the efficiency of internal combustion engines is lowered to 60-70 percent of normal,

UPPER—Looking east from Station 13 showing melting snow condition, July 1950. LOWER—Looking west where spring appeared in traveled way, July 1950

was used for the majority of the import, was located on a hillside and composed of a combination of water-borne material and DG. Possibly the water-borne material had contained many large boulders which in the course of time had disintegrated. This pit was located $4\frac{1}{2}$ miles west of the project and necessitated an up-hill haul with the loaded trucks.

Glacial Results

The geologic map shows the area to the east of the park boundary as being Jurassic-Triassic meta-volcanics, and the material inside the park as being Jurassic acid intrusives. However, the writer believes that it was not so much this possible variation in source material as it was the glacial action which caused the one material to be satisfactory and the other unsatisfactory. This is borne out by the fact that clays would not be expected from volcanic source material (and clays were not found in the existing base material, as shown by low PI or NP), and by the fact that the material taken from inside the park was of a post glacial origin, both by water transportation and weathering, and clays from the kaolinization of the feldspars had not progressed sufficiently to cause a large clay fraction to be present. The failure was apparently caused by the original material being too amenable to flow under saturated conditions, and it was hoped that the addition of

and the efficiency of human beings suffered likewise. Added to these factors was the early cold weather. The project started on August 10, 1948, and by August 15th, it was below freezing at night. The asphaltic emulsion for the seal on the cement-treated material was stored in a steel tank with outside wooden walls, and flares were left lighted around it at night to keep it from freezing.

Scarified Material

The scarified material was rolled with a 6-ton tandem roller to break it up and then windrowed with the imported material. This combined material contained about 2.5 percent moisture. Tests showed 6.5 percent average optimum moisture; however, it was found that at this elevation and climate a better result was obtained by using about 8 percent. The additional 1½ percent moisture was necessitated by the drying and powdering of the finished surface before the seal could be applied. By placing half of the water in the windrow and half in the mixer a more workable mix was obtained.

The material was mixed with a Barber-Greene heavy duty travel plant, Model 848. This was followed within 250 feet by a motor grader and a 12-ton three-wheel roller, and then sealed with penetration type asphaltic emulsion, using 0.2 gallons per square yard applied from an emulsion kettle, and then sanded using an Oregon type sand spreader. The maximum time lapse between mixing and sealing was 1½ hours and usually more nearly one hour. One half of the road was mixed at a time.

UPPER—Barber-Greene heavy duty travel plant in operation. Tioga Lake in background, 1948. LOWER—Looking west at Camp Tiogo. Cut in foreground was one of worst failures before construction due to seeps and winter frost boils. Taken July, 1950 after two winters

Looking east showing cement-treated material completed on left side. Traffic controller on right. 1948, during construction

Slight Failure

Between Stations 18 and 25, a slight failure, chuckholing, occurred on September 15th due to construction truck traffic and unusually heavy traffic during the hunting season. This failure was caused by the combination of a sharp curve and sudden steepening of the grade. Cars going upgrade had to round the curve at a comparatively slow speed and then shift gears, and cars coming downgrade were forced to apply their brakes suddenly to ap-

Looking east showing 4.5-foot windrow being mixed. Traffic controller on left side on already laid cement-treated material. During construction, 1948

the middle of the traveled way. This was corrected by placing suitable rock drains.

Experience to date has shown that low cement-treated base can be successfully laid at the higher altitudes under adverse weather conditions; however, consideration must be given to the cost of such treatment with particular emphasis on the reduced efficiency of all power driven equipment, as well as to the reduced efficiency of the human being at 10,000 feet elevation.

The project was performed under the general direction of S. W. Lowden, District Engineer, since transferred to San Bernardino; M. E. Fischer, District Maintenance Engineer; and under the immediate supervision of C. P. Carter, Highway Superintendent; Vaughn Marker, Resident Engineer; and J. Van Dyk, Highway Foreman.

proach the curve at a reduced speed. Also, tests had shown this to be the poorest material, about 190 psi. The chuckholes were filled and a light 1-inch-2-inch cover of roadside material was bladed over them. The cement treatment was finished on September 22d and the first snow came on September 24, 1948.

In July, 1949, work was resumed. A surfacing of three inches of road-mixed surfacing was laid in two courses, using imported mineral aggregate from the pit inside the park and SC-3 at the rate of 0.75 gallons per square yard one inch thick. There was very little and only minor damage showing to the cement-treated surface from the winter season.

A Class "D" seal of penetration type asphaltic emulsion was applied at the rate of 0.1 gallon per square yard. The project was completed October 13, 1949, and the first snow fell on October 14th.

Inspections Show Success

Inspections were made in June, 1950, by M. E. Fischer, District Maintenance Engineer, and the writer, at the time the snow removal equipment was in operation, and again in July. There was very little apparent damage from either snow removal equipment or effects of winter weather. The Snogo did not sink in as was experienced previous to this treatment. There was only one place showing effects of frost boil, and that was where construction operations had opened up a spring in

UPPER—Showing mixing operations. Note spacing of equipment. 1948. LOWER—Mixing operations. Note spacing of equipment. 1948

Livermore By-Pass

Section of Freeway on Route U. S. 50 Completed

By J. F. O'BRIEN, Resident Engineer

Completion of the 5.8 mile section of freeway from the foot of the Altamont Pass to one and one-half miles west of Livermore in Alameda County, provides much needed traffic relief between the San Francisco Bay area and the San Joaquin Valley on this portion of Route U. S. 50. The traffic count taken on this route east of Livermore, in July, 1950, showed a 24-hour Sunday volume of over 19,000 and a Monday volume of over 11,000 vehicles.

Another section of this route from the westerly terminus of this contract, for a distance of 5.9 miles westerly to a connection at Hopyard Road, is now under contract and should be completed for the summer traffic in 1951.

A third section from Hopyard Road westerly to Boomer Hill in Dublin Canyon is now on the drafting tables and is planned for contract construction in the near future.

An 8.4 mile section of the Altamont Pass between Greenville and the Mountain House was constructed as a four-lane divided highway in 1938; and while this construction was completed before the freeway law became effective, its design carried many of the present freeway features and provides satisfactory traffic service over its length.

Future projects are progressively planned to provide freeway transportation facilities from the Oakland Metropolitan area to the San Joaquin Valley, and connecting outlets north, south and east to meet the heavy traffic demands of the area.

This route, in addition to the heavy passenger car traffic, carries a very heavy truck traffic, as it serves as a primary outlet for produce from the fertile San Joaquin Valley and adjacent areas, recent traffic counts indicating 19.6 percent of the traffic volume being trucks.

The importance of this route from a military standpoint has been well established, as in addition to its cross-country connections it is the most direct route from Lyoth Quartermaster Depot and the Lathrop Holding and Reconsignment Point to the San Francisco Port of Embarkation.

The 5.8 mile section of freeway just completed replaces an outmoded two-lane roadway. A portion of the project follows the old location for approximately two miles, this portion being reconditioned to serve as the eastbound lanes of the new freeway.

A line change northerly of the old route on direct alignment between terminal limits of the project on easy grades and long radius curves, saves 2,800 feet in distance, the maximum grade being 1.56 percent and the minimum radius being 3,000 feet.

The right of way for this project is of variable width as necessary to fit the development, providing 220 feet where frontage roads are constructed to 180 feet in the flat farm land areas, and was acquired at a cost of approximately $410,000, including the cost of clearing improvements and utilities.

This project was let to contract in two stages, the first being for the initial grading and separation structures at Beck Road and a bridge over Las Positas Creek, and was awarded to Dan Caputo and Edward Keeble of San Jose in October, 1948, and completed

Showing section of completed freeway with relocated county road on left

UPPER—Showing typical traffic congestion on old road before improvement. LOWER—Looking east, showing section of freeway where old road was developed as eastbound lane. Frontage roads shown right and left

in September, 1949, at a construction cost of $497,000.

Roadway Widened

A second contract for paving the graded section and development of the portion of the old road to incorporate same into the completed four-lane divided freeway, was awarded to Harms Bros. and N. M. Ball Sons of Berkeley, in June, 1949, and completed in September, 1950, at a construction cost of $945,000.

This project consisted of widening 2.2 miles of the old 20-foot pavement to 24 feet, and resurfacing same to form the eastbound lanes of the freeway in this area.

The balance of the freeway pavement is Portland cement concrete construction, which provides two 12-foot traffic lanes in each direction divided by a 36-foot division strip.

Illuminated channelizations at grade are provided at the easterly and westerly ends of the project, at Laughlin and Vasco roads, and at the connection to State Highway Route 108.

Frontage Roads

Frontage roads were constructed along both sides of the freeway for

. . . Continued on page 19

PROMOTIONS IN DIVISION OF HIGHWAYS RANKS

Ridgway M. Gillis, Assistant State Highway Engineer, has been appointed by State Highway Engineer George T. McCoy to be Deputy State Highway Engineer to succeed Fred J. Grumm, who retired on July 31, 1950.

Gillis has been in state service since 1929 when he came to the California Division of Highways to be Assistant Construction Engineer. He remained in that position until 1933, when he was promoted to District Engineer at

EARL WITHYCOMBE

Fresno, in which capacity he served until 1938. From 1938 to 1947 he was State Highway Construction Engineer and when the division was reorganized in 1947 to meet the increased work under the Collier-Burns Act, Gillis became Assistant State Highway Engineer in charge of Operations, which includes construction, maintenance, equipment and laboratory.

Gillis, a native Californian, was born in Oakland, October 22, 1885, and is a graduate of Whitman College and of Massachusetts Institute of Technology, C.E. degree. After graduation from college he was with the Wash-

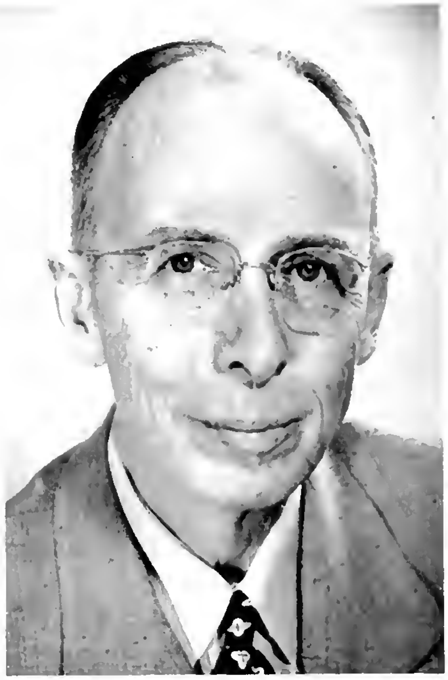
R. M. GILLIS

ington State Highway Department from 1912 to 1926, and thereafter with the Pacific Bridge Company until 1929. He is president of the Sacramento Section of the A. S. C. E. and a member of the Advisory Committee of the Institute of Transportation, and Traffic Engineering of the University of California, representing the Division of Highways. He resides in Sacramento with his wife.

McCoy appointed Earl Withycombe, Construction Engineer of the Division of Highways, to succeed Mr. Gillis as Assistant State Highway Engineer, Operations, and Chas. E. Waite, Engineer of Design, to be in charge of personnel and public relations with the rank of Assistant State Highway Engineer, succeeding J. G. Standley who retired on September 30th.

Withycombe graduated from Oregon State College, Corvallis, in civil engineering in 1911. His early training was largely in railroad and highway location and construction on the Pacific Coast. He served with the engineering forces during World War I, coming to California as engineer for the Napa Valley Electric Railway in 1921.

In February, 1922, Withycombe entered state service as Resident Engineer on pavement construction in District VI of the Division of Highways. He advanced to Assistant Construction Engineer in March, 1924, and covered all construction projects in the State for Headquarters Office for many years. He advanced to the post of Staff Highway Engineer in the construction department in May, 1931, and in Octo-



CHAS. E. WAITE

ber, 1947, was elevated to the position of Construction Engineer for the Division of Highways.

Waite, who graduated in civil engineering from the University of Oklahoma in 1922, came to California in 1927, and was engaged in private practice until March, 1929, when he entered the service of the Division of Highways as a designer in District II, Redding. He transferred to construction in 1930, and for three years was on the Feather River Highway project. From 1933 to 1935, he was Assistant District Maintenance Engineer in District VI, Fresno.

. . . Continued on page 13

Traffic Count

Figures for 1950 Show an Increase of 9.4 Percent Over 1949

By G. T. McCOY, State Highway Engineer

The annual state-wide traffic count taken on Sunday and Monday, July 16th and 17th, shows an increase of 9.4 percent over the immediately preceding annual count of 1949. Sharply reversing the 1949 count, which showed passenger car traffic increasing at a greater rate than freight vehicles, this year's count shows a greater increase in freight vehicles than in passenger cars. The "Main North and South Routes" and the "Interstate Connections" show the greatest traffic increases while the "Recreational Routes," which carry a minor percentage of the total traffic volume, show a slight decrease. All route groups show a greater gain in Monday than in Sunday traffic, with the "Interstate Connections" registering the greatest increase in Monday traffic.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday, totals being shown for each hour. At selected representative stations, counts are also continued for the entire 24-hour period and are extended to record each of the seven days of the week. Traffic is segregated into the following vehicle classifications: California passenger cars, out-of-state passenger cars, busses, pickups, two-axle commercial units, three-axle units, four-axle units, five-axle units, and six-or-more-axle units.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded in determining comparison with the previous year, only those stations that were identical during both years being taken into consideration.

These comparisons for the various route groups are as follows:

PERCENT GAIN OR LOSS FOR 1950 COUNT AS COMPARED WITH 1949

	Sunday	Monday
All Routes	+ 7.99	+ 9.56
Main North and South Routes	+10.86	+11.10
Interstate Connections	+ 9.88	+14.59
Laterals Between Inland and Coast	+ 5.21	+ 7.81
Recreational Routes	— 1.20	— 0.14

The gain or loss of traffic volume for State Highway Routes 1 to 80, inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

Route	Termini	1950 Percent gain or loss Sunday Gain	Sunday Loss	Monday Gain	Monday Loss
1.	Sausalito-Oregon Line	9.00		17.03	
2.	Mexico Line-San Francisco	16.19		11.15	
3.	Sacramento-Oregon Line	8.24		10.28	
4.	Los Angeles-Sacramento	10.90		9.23	
5.	Santa Cruz-Jct. Rt. 65 near Mokelumne Hill	0.65		6.26	
6.	Napa-Sacramento via Winters	10.24		16.66	
7.	Crockett-Red Bluff	8.53		14.11	
8.	Ignacio-Cordelia via Napa	6.48			0.13
9.	Rt. 2 near Montalvo-San Bernardino	6.54		9.07	
10.	Rt. 2 at San Lucas-Sequoia National Park		5.66	0.10	
11.	Rt. 75 near Antioch-Nevada Line via Placerville	8.13		8.03	
12.	San Diego-El Centro	1.47		6.59	
13.	Rt. 4 at Salida-Rt. 23 at Sonora Jc.		3.17		0.15
14.	Albany-Martinez	8.30		12.11	
15.	Rt. 1 near Calpella-Rt. 37 near Cisco	2.40		7.27	
16.	Hopland-Lakeport	16.00		18.92	
17.	Rt. 3 at Roseville-Rt. 15, Nevada City	13.99		13.78	
18.	Rt. 4 at Merced-Yosemite National Park	5.81		7.39	
19.	Rt. 2 at Fullerton-Rt. 26 at Beaumont	13.41		10.76	
20.	Rt. 1 near Arcata-Rt. 83 at Park Boundary	15.20		17.27	
21.	Rt. 3 near Richvale-Rt. 29 near Chilcoot via Quincy		5.05		2.35
22.	Rt. 56, Castroville-Rt. 32 via Hollister		27.62		30.27
23.	Rt. 4 at Tunnel Sta.-Rt. 11, Alpine Jc.	15.30		8.91	
24.	Rt. 4 near Lodi-Nevada State Line		3.58	4.32	
25.	Rt. 37 at Colfax-Rt. 83 near Sattley	6.34		28.73	
26.	Los Angeles-Mexico via San Bernardino	4.89		5.50	
27.	El Centro-Yuma	7.07		9.60	
28.	Redding-Nevada Line via Alturas	3.00			1.28
29.	Peanut-Nevada Line near Purdy's	8.24		11.04	
31.	Colton-Nevada State Line	18.04		25.86	
32.	Rt. 56, Watsonville-Rt. 4 near Califa	9.76		10.20	
33.	Rt. 56 near Cambria-Rt. 4 near Famoso	14.75		10.36	
34.	Rt. 4 at Galt-Rt. 23 at Pickett's Jc.	15.81		10.24	
35.	Rt. 1 at Alton-Rt. 20 at Douglas City	13.04		16.59	
37.	Auburn-Truckee	3.05		20.07	
38.	Rt. 11 at Mays-Nevada Line via Truckee River	1.57			3.26
39.	Rt. 38 at Tahoe City-Nevada State Line	21.22		5.96	
40.	Rt. 13 near Montezuma-Rt. 76 at Benton	7.09		6.99	
41.	Rt. 5 near Tracy-Kings River Canyon via Fresno	8.04		13.71	
42.	Redwood Park-Los Gatos		1.95		4.97
43.	Rt. 60 at Newport Beach-Rt. 31 near Victorville		3.18	1.71	
44.	Boulder Creek-Redwood Park		16.35		6.49
45.	Rt. 7, Willows-Rt. 3 near Biggs	7.82		12.78	
46.	Rt. 1 near Klamath-Rt. 3 near Cray	33.45		27.77	
47.	Rt. 7, Orland-Rt. 29 near Morgan	3.58		4.37	
48.	Rt. 1 N. of Cloverdale-Rt. 56 near Albion	22.93		14.22	
49.	Napa-Rt. 15 near Sweet Hollow Summit	4.14		5.48	
50.	Sacramento-Rt. 15 near Wilbur Springs	2.89		13.91	
51.	Rt. 8 at Shellville-Sebastopol	15.98		12.00	
52.	Alto-Tiburon		7.41	21.01	
53.	Rt. 7 at Fairfield-Rt. 4 near Lodi via Rio Vista	13.52		37.66	
54.	Rt. 11 at Perkins-Rt. 65 at Central House	9.71		8.00	
55.	Rt. 5 near Glenwood-San Francisco		7.75		6.60
56.	Rt. 2 at Las Cruces-Rt. 1 near Fernbridge	0.26		0.60	
57.	Rt. 2 near Santa Maria-Rt. 23 near Freeman via Bakersfield		5.37	3.10	
58.	Rt. 2 near Santa Margarita-Arizona Line near Topock via Mojave and Barstow	8.37		9.16	
59.	Rt. 4 at Gorman-Rt. 43 at Lake Arrowhead	4.47		5.56	
60.	Rt. 2 at Serra-Rt. 2 at El Rio	2.00		7.59	
61.	Rt. 4 S. of Glendale-Rt. 59 near Phelan	2.96		6.98	
62.	Rt. 171 at Northam-Rt. 61 near Crystal Lake	9.37		6.81	
63.	Big Pine-Nevada State Line	44.28			0.20
64.	Rt. 2 at San Juan Capistrano-Blythe		0.73	5.68	
65.	Rt. 18 near Mariposa-Auburn	2.96		8.66	
66.	Rt. 5 near Mossdale-Rt. 13 near Oakdale		3.21		0.61
67.	Pajara River-Rt. 2 near San Benito River Bridge		39.85		34.56
68.	San Jose-San Francisco	5.17		13.13	
69.	Rt. 5 at Warm Springs-Rt. 1, San Rafael	7.24		9.30	
70.	Ukiah-Talmage	23.57		2.50	
71.	Crescent City-Oregon Line	22.55		29.74	
72.	Weed-Oregon Line	23.09		10.70	
73.	Rt. 29 near Johnstonville-Oregon Line	20.37		24.94	
74.	Napa Wye-Cordelia via Vallejo and Benicia	1.05		6.00	
75.	Oakland-Jc. Rt. 65 at Altaville	20.35		20.04	
76.	Rt. 125 at Shaw Ave.-Nevada State Line near Benton		15.51		18.65
77.	San Diego-Los Angeles via Pomona	17.09		10.33	
78.	Rt. 12 near Descanso-Rt. 19 near March Field	6.53		3.51	
79.	Rt. 2, Ventura-Rt. 4 at Castaic	8.47		14.78	
80.	Rt. 51, Rincon Creek-Rt. 2 near Zaca	6.25		6.25	

HELP SAFETY PATROLS

School Safety Patrols are again on duty, protecting classmates against traffic hazards. When you see a Safety Patrol boy, slow down immediately and be prepared to stop if children are about to cross. Your cooperation will save young lives.

Covered Bridges

Last Two of Such Structures Removed From State Highways

During California's Centennial Year, 1950, the last covered bridges were removed from the State Highway System. The covered bridge has long been a nostalgic symbol of what we like to regard as "the good old days," when life was simpler and less mechanized.

Although several covered bridges still remain on the County Road System, during recent years only two had survived on the state highways. These last two covered bridges were well off the beaten track over Clear Creek and Dillon Creek near Orleans, on the road which follows the Klamath River from Weitchpec to U. S. 99 near Hornbrook.

Paradoxically, however, rather than being holdovers from a previous era, these two bridges were built in 1921 and 1922, by the U. S. Bureau of Public Roads when at that time the first road was constructed into this primitive area. Prior to building the road through, the only means of access to this part of Siskiyou County had been over pack trails. These two covered bridges, basically timber trusses under their sheet metal housings, served miner, logger, and vacationer alike for almost 30 years. With the increase of highway loads, however, and the advance of decay and general deterioration, they became inadequate and it was found necessary to replace them.

Narrow Bridges

In addition to this deterioration, both bridges were one-way and dangerously narrow, Clear Creek having a roadway width of 11 feet, while Dillon Creek provided only 15 feet 9 inches between curbs.

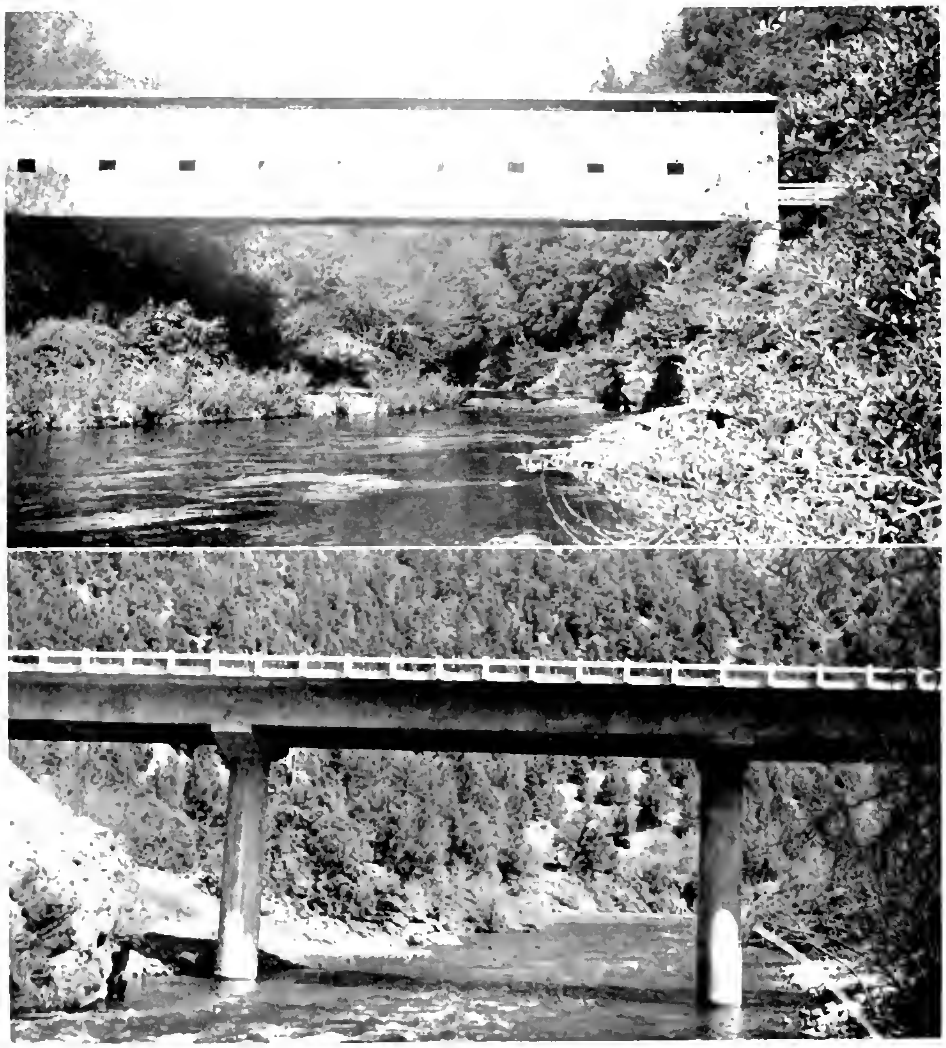
Designed to serve extremely infrequent traffic, these narrow widths were considered adequate, as was the tortuous alignment with sharp curves at each end of the bridges. The old structures were designed to carry only a 10-ton truck, whereas the design of the new structures is capable of sustaining a 20-ton truck pulling a 16-ton semi-trailer. Clearances also were limited on the old structures. Less than 14 feet were provided, whereas the new bridges of girder design allow an unlimited vertical height.

Will Aid Logging

The replacement of these two old covered structures will remove the last serious load limit restriction from this highway. It will now be possible for logging trucks to bring out the full legal limit of logs and for the miners to haul in their heavy equipment over new structures which will sustain all the law allows.

Although they were old and had exceeded their economic service life, when it came to knocking down the old bridges, they still resisted strongly. Holes were drilled in each panel point of the upper and lower chords of the trusses. The holes were then loaded with powder and simultaneously detonated. The old Dillon Creek Bridge splintered under the blast, but the trusses did not fall. The second blast was necessary to bring the bridge crashing into the canyon.

Upper—Old covered bridge across Clear Creek replaced by new structure, lower



The new Clear Creek Bridge is a modern concrete girder structure on single column bents. It has a center span of 70 feet and two side spans each 58 feet long. A 24-foot roadway is provided and the alignment is improved so that the entire structure as well as the approaches are on a 1,400-foot radius horizontal curve. The contract cost was about $135,000, including two-thirds of a mile of highway approach.

The new Dillon Creek Bridge is a steel girder structure with a 101-foot main span and two short approach spans. Twenty-four feet is also provided for the roadway on this structure and the alignment has been improved to provide a 600-foot radius horizontal curve. The approximate cost of the Dillon Creek Bridge was $170,000.

The structures were both built under Bridge Department contracts and both were constructed by the same contractor, G. M. Carr and Bati Rocca. Mr. John Gressitt was Resident Engineer on the Clear Creek Bridge and A. F. Kay was Resident Engineer on the Dillon Creek Bridge.

Completion of these two new bridges should do much to open the timber, mineral and recreational resources of Siskiyou County and will prove valuable additions to the highway system as California enters her second century.

Picturesque old covered bridge across Dillon Creek, upper, replaced by modern structure shown below

Promotions

Continued from page 10 . . .

During the period 1935-42, he was Assistant Office Engineer in Headquarters, Sacramento. From 1942 to 1947, he was District Construction and Location Engineer in District V, San Luis Obispo. For two years, 1947-49, he was District Engineer in District X, Stockton and in 1949, was transferred to Headquarters in Sacramento as Design Engineer, from which post he was elevated to Assistant State Highway Engineer.

Waite is a member of the American Society of Civil Engineers, and a member of the Design Committee of the American Association of State Highway Officials and the Highway Research Board.

E. T. Telford was appointed Engineer of Design in the Sacramento office to succeed Waite. Telford has been employed with the Division of Highways continuously from 1932 to the present except for five years when was with the Army. He has been in the Design Department as assistant since August, 1946.

F. N. Hveem was appointed Construction Engineer at Headquarters to succeed Earl Withycombe who is now Assistant State Highway Engineer in charge of Operations. Hveem has been with the department since 1917, his latest assignment having been Supervising Materials and Research Engineer at the highway laboratory, Sacramento.

J. P. Murphy was appointed Principal Highway Engineer in the office of Public Relations and Personnel at Headquarters. Murphy has been with the Division of Highways since 1930, with the exception of three years in the Marines during World War II. Prior to this appointment he was Assistant District Engineer at District II, Marysville.

E. J. Saldine was appointed Principal Highway Engineer in the Operations Office. He has been employed by the Division of Highways continuously since 1924. For many years he was assigned to the office of personnel.

S. W. Lowden was appointed District Engineer of District VIII, San Bernardino. He has been with the division since 1912, except for about a year. Prior to this appointment he was District Engineer at Bishop.

Alan S. Hart succeeds Lowden at Bishop. He has been with the division since 1930, prior to this appointment having been Assistant District Engineer, District I, Eureka.

County Project

Butte County Completes Chico-Paradise Skyway

By E. H. WYMAN, Associate Highway Engineer, and B. N. PAXTON, Butte County Road Commissioner

On August 30, 1950, in Butte County, the Chico-Paradise Skyway, F. A. S. 757, was officially opened to traffic by Frank B. Durkee, Deputy Director of Public Works, at a dedication ceremony climaxing a two-day opening celebration in Paradise, the terminus of the nine-mile project.

The project is an outstanding example of effective state-county cooperation. The county secured necessary rights of way, a considerable portion of which were donated, and the County Road Organization, which is set up under the Butte County Charter as a definite department of the county government, did the major portion of the preliminary engineering. The work of the county in this regard was reviewed and approved by the state and federal authorities.

The project has been received with enthusiasm throughout the Chico-Paradise district, as the most important highway development accomplished in northern Butte County in over 25 years.

The new road closely parallels the Chico-Stirling City branch of the Southern Pacific Railroad and traverses a narrow lava ridge overlooking the 300- to 500-foot sheer walls of rugged Butte Creek Canyon. The road virtually eliminates travel over the steep, narrow and winding Honey Run Road with its historic old three-span covered timber bridge. A greater portion of the Neal Road traffic will also be diverted over the new alignment. The unique community of Paradise will be serviced by the new road which reduces the distance to Chico by three and one-half to four miles and cuts the travel time to approximately one-third of the old.

Traffic counts taken since completion of the project indicate 2,300 to 2,500 vehicles per day are using this improved route.

History of Paradise

Located on Paradise Ridge and in the immediate vicinity are many pioneer mining camps dating from the days of the Argonauts of '49. Among these are Dogtown, Helltown, Toadtown, Cherokee Diggings (where diamonds still are found), Ramsey Bar, Whiskey Flat, Nimshew, Nelson's Bar, Yankee Hill, and many others whose names were made memorable in the writings of Bret Harte and other western writers. One of the world's largest nuggets and the second largest ever found in California, the famous Dogtown or Magalia nugget, was found August 14, 1859, at the Willard Mine near Sawmill Peak, directly across the canyon from Magalia. The nugget weighed 54 pounds in the rough and when reduced it produced 49½ pounds of gold, worth at that time $10,960.

Following the gold rush, between 1853 and 1855, "diggin's" were discovered nearby, and because of its mild climate, Paradise became the winter home of many miners. During the Civil War period the first sawmills in the vicinity began producing lumber—among them that of "Uncle Billy" Leonard's. From that time this section was known officially as "Leonard's Mill" until about 1865 when "Uncle Billy" gave it the name of Paradise.

Deputy Director of Public Works Frank B. Durkee (center) cuts ribbon at opening of Chico-Paradise Skyway. On his right is Supervisor Frank L. Patty, and on his left is Supervisor John N. Bille, both of Butte County

UPPER—Completed section of Chico-Paradise Skyway, showing lava cut and Butte Creek Bridge. LOWER—View looking westerly showing sheer walls of lava cap. Five hundred feet of retaining wall had to be constructed below guard rail on left

Rapid Growth

Since the mid-forties this residential community has had a phenomenal influx of residents due to retired city dwellers seeking a mild climate and restful homesites, and because of Sacramento Valley residents building here to escape the summer heat and winter fogs. Due to this rapid growth it became more and more apparent that the existing roads were inadequate.

Money Allotted

With the appropriation of state funds under authority of Chapter 565, Statutes of 1943, location surveys and construction plans were started in the fall of 1944 under the direction of B. N. Paxton, County Road Commissioner. The proposed project was first reviewed December 10, 1945, by representatives of the State, the B. P. R., and Butte County. The estimated cost of construction exceeded the amount Butte County could allot at that time. The following year after supplemental allotments became available and by utilizing F. A. S. and state funds, together with A. B. Chapter 20 and

Looking easterly showing right of way constructed between railroad embankment and edge of bluff

county funds over half a million dollars was programed for the project.

The project began about two miles east of Chico and extended northeasterly a distance of nine miles over new alignment and rights of way to Paradise. It was done in stage construction, the first stage being the construction of a graded roadbed with crushed gravel base, and the construction of a reinforced concrete bridge over Butte Creek. Granite Construction Company of Watsonville, the contractor, completed this section at a cost of $420,000. This was by no means an easy job and the contractor, his personnel and the engineers are to be commended on the excellent work they accomplished under adverse conditions.

The greater portion of the excavation areas were either a hard lava cap or cemented lava boulder formation, and considerable difficulty was encountered in blasting the formations. Although the contractor experimented with different patterns of shooting and the use of different percent dynamite, a great amount of secondary shooting was necessary. Some cuts had to be reshot four and five times. Ed Spaith was superintendent for the contractor. Engineering was supplied by both Butte County and the State with P. J. Totman representing the county and

Looking up center line, showing typical construction difficulties encountered for nearly full length of project

M. E. Ryan representing the State. Construction started in November, 1948, and was completed in November, 1949.

After a winter layover the final stage, placing of 0.25-foot plant-mixed surfacing and construction of shoulders, was started in early May of 1950 and completed in late July at a cost of $112,000. C. E. Harless was superintendent for the A. G. Raisch Company of San Rafael, the contractor on this phase. E. H. Wyman of Butte County was resident engineer with R. E. Biggs representing the State.

The new two-lane construction consists of a 40-foot graded roadbed with 0.5-foot to 0.67-foot x 34-foot crushed gravel base, and 22-foot x 0.25-foot plant-mixed surfacing with 5-foot x 0.25-foot untreated rock surfacing shoulders. There are only 12 curves in the nine miles, the minimum radius being 800 feet and the grades are generally easy with one short section of 6.2 percent. There is a rise of 1,300 feet between the beginning and the end of the project.

TRUCK TURNING LANES

Reprints of an article which first appeared in *California Highways and Public Works*, March-April, 1950, by J. C. Young, Traffic Engineer of the California Division of Highways, on truck turning lanes and off-tracking of trailer combinations, are available by writing him at P. O. Box 1499, Sacramento, California.

U.S. 395

Route Now Has 59 Miles of Freeway in San Diego County

Another new section of U. S. 395 was opened in San Diego County on Thursday, September 14, 1950. With the completion of this 18.3 mile, $3,476,000 improvement, this route gained the distinction of having 59 miles of freeway or limited access construction.

Dedication ceremonies were held at 3.30 p.m. at Miramar, 4.5 miles north of San Diego. Participants in the opening were, Aubrey Davis, President of the Highway Development Association, and representatives of the Chambers of Commerce in Riverside, San Bernardino, and San Diego Counties; State Highway Commissioners C. T. Leigh of San Diego, Harrison R. Baker of Pasadena, and James A. Guthrie of San Bernardino; C. H. Purcell, Director of Public Works; G. T. McCoy, State Highway Engineer; E. Q. Sullivan, former District Engineer at San Bernardino, and E. E. Wallace, District Engineer, San Diego.

Three Nations Represented

C. Arnholt Smith, former State Highway Commissioner from San Diego, had the honor of cutting the ribbon, as it was during his term that the Cabrillo Freeway, another section of U. S. 395, was built, and the grading contracts started on the section just completed.

Since this highway links three nations, Canada, Mexico, and the United States, it was appropriate that representatives from those two countries be present. Miss Enid Lickorish of Canada, and Senor Luis Orci of Mexico, assisted Smith as he cut the ribbon which permitted a five-mile caravan of over one hundred cars to sweep northward over the new freeway and into Escondido, where the ceremonies were concluded with a dinner at the Daughtery Ranch.

Many Years of Planning

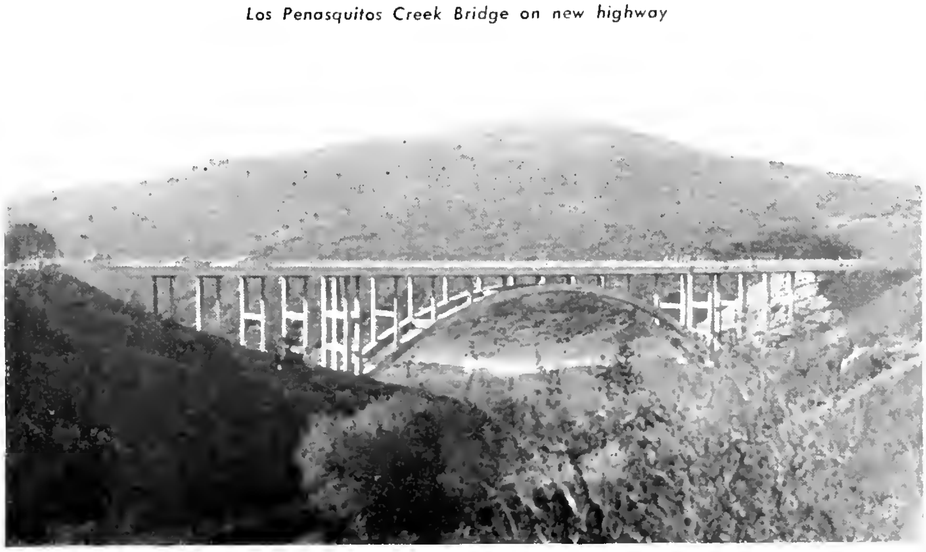
The completion of this new freeway culminates many years of planning.

Section of U. S. 395 as it existed prior to opening of new route

The original reconnaissance report was submitted in June, 1938, and considered four routes between San Diego and Escondido. At that time, improvement of the existing alignment was favored due to the possibility of a Poway-Ramona connection at Poway Creek Bridge. Then, as in so many cases, the war clouds developed and no action was taken. In 1943, the project became a part of the postwar program, and another reconnaissance study on the new alignment was authorized extending from Miramar to Lake Hodges. This report was submitted in March, 1944. Surveys were begun and preliminary report submitted in December, 1944. Finally, in 1948, it was possible to again resume work on the project.

The length just completed was divided into two sections, from the North City Limits of San Diego to Miramar, and from Miramar to Lake Hodges. Two contracts were let in June of 1948 covering the grading and

Los Penasquitos Creek Bridge on new highway



structures. Three bridges were included in these contracts, a reinforced concrete girder at San Clemente Canyon, a reinforced concrete box girder bridge at Green Valley Creek, and a reinforced concrete open spandrel arch bridge, 434 feet over-all length with an arch span of 220 feet, at Penasquitos Creek. The two surfacing contracts were awarded in April, 1950, and progressed simultaneously.

Cost of Project

Surfacing of the southerly end, from the north city limits to Miramar, 6.5 miles in length, was done by Cox Bros., at a cost of $1,114,577. The cost of the northerly section, 11.8 miles in length, on which Peter Kiewit was the contractor, amounted to $1,873,561. Both of these figures are exclusive of right of way and engineering costs.

One large, and several small, unsuspected slides which developed on the northerly grading contract complicated matters considerably for a time.

The largest slide occurred under conditions which are ordinarily stable, and was somewhat unique in that respect. This slide was of a circular type, the back trace was at a maximum distance of 200 feet from center line, with the upheaval crack or toe approximately along the roadway center line. The total mass of earth involved was approximately 80,000 cubic yards.

Several power borings 36 inches in diameter were made in order to confirm the assumption that no earth movement was expected elsewhere subsequent to unloading this slide.

This slide continued to move during the six-day period following the initial movement and cracking. Free water was found in some of the borings near the slip plane.

Stability Achieved

Following field studies and conferences, a method was evolved for achieving stability, which consisted of removal of 22,777 cubic yards from the slide area and raising of the roadway grade through the cut sufficiently to obtain calculated stability.

The only section of U. S. 395 between A Street in San Diego and the Riverside County line remaining unim-

UPPER—Looking north on new route, showing transition from four lanes to two lanes. CENTER—Looking north, showing transition from two lanes to four lanes at blind curve, top center. LOWER—This view is looking north on the new route

proved is the bridge across Lake Hodges. Progress on this proposed bridge is dependent on a decision by the City of San Diego with regard to a contemplated increase in the capacity of the reservoir, which would require a bridge at approximately 75 feet higher elevation than the present one. Anticipating this increased reservoir capacity, the roadbed of the new highway southerly from Lake Hodges was placed at elevations that would clear the probable raise in level of the lake.

The savings in distance, and the cost of the projects accomplishing these savings are listed below. These figures cover the entire length of the reconstructed U. S. 395 between A Street in San Diego, over the Cabrillo Freeway, continuing through Miramar, Escondido, to Lake Hodges, and north to the Riverside County line.

Section	Cost	Saving in distance
A St. to north city limits	$4,020,592	3.3 miles
North city limits to Miramar	1,114,577	
Miramar to Lake Hodges	1,873,561	2.3 miles
1 mi. S. Escondido to N. C. L.	654,305	0.5 miles
N. C. L. Escondido to Rainbow	2,283,839	11.0 miles
Rainbow to Riverside County line	217,490	0.4 miles
	$10,164,865	17.5 miles

Future Four-lane Widening

The project was designed for future four-lane widening without having to acquire additional right of way. Two hundred-foot width of right of way was acquired to permit this future development when traffic warrants. In the meantime, the section from the north city limits to Miramar is entirely four-lane divided highway. The section from Miramar to Lake Hodges is a combination two- and four-lane design, having four lanes on all blind summits or other locations where sight distance is impaired, and two lanes where the four-lane section is not warranted.

Looking north from Linda Vista Road

A rather interesting feature of this construction is in the planning and work which was required through the Navy's Homoja Housing Development. Eighteen buildings had to be moved, utilities relocated, etc. The Eleventh Naval District extended every cooperation in this operation, moving the families to temporary housing during the relocation. It also cooperated to the fullest extent in clearing the rights of way through the Camp Elliott properties.

As is indicated in the following tabulation, the traveler will save both time and mileage, with less fatigue when driving over this reconstructed highway, and the improvements already accomplished, together with those contemplated in Riverside County will make the San Diego County Beaches and the harbor much more accessible to our northern neighbors.

Comparative Data—Alignment and Grade

Item	New	Old
Length	12.2 miles	14.5 miles
Number of curves	13 *	79
Total central angle	194 *	2684
Maximum radius	15,000′	6,000′
Minimum radius	2,000′ *	180′
Number of curves under 500′ radius	None	38
Maximum grade	6%	6.13%
Roadbed width (including shoulders)	38′	30′ avg.

** Temporary connection with one 800-foot radius curve and limited sight distance not included.*

The Colorado Freeway

Continued from page 2 . . .

Channel Work Required

Major regrading and filling will be necessary along the channel of the Arroyo and on the easterly slope. It is proposed to flatten the precipitous east bank by placing excess excavation material in this area and to provide a parklike right of way which can be readily landscaped.

Ultimate protection of the piers of both bridges requires completion of the remaining link of the channel lining by the Los Angeles County Flood Control District. The new location for the lined channel will be under the 319-foot arch span. This change will provide a more symmetrical setting for the arch spans, the existing channel being too close to the east side of the arroyo.

As the new bridge will carry freeway traffic, no provision will be made for pedestrians. Stairways will be provided at the west end of the existing bridge for pedestrian access to Linda Vista Avenue and the areas under the bridges.

A model on a scale of 1 inch = 20 feet has been made so that the bridge and its surroundings may be viewed in three dimensions. By this means it is possible to see the harmonious appearance of both the old and new structures in relationship to their surroundings.

Livermore By-Pass

Continued from page 9 . . .

approximately two miles from the easterly end, to serve the built-up sections of adjacent property.

New truck scale sites were constructed on each side of the freeway near its easterly end; and 40-ton platform scales as truck weighing facilities for use by the California Highway Patrol have been installed.

This work was done under the general direction of Assistant State Highway Engineer Jno. H. Skeggs, with the author as Resident Engineer, and was financed by state gas tax and federal-aid funds.

Progress Report

On Santa Ana Freeway From Norwalk to Miraflores

By WALLACE M. McKNIGHT, A. J. A. LYNN and PATRICK J. KENNELLY
Assistant Resident Engineers

Completion of three current projects in District VII will add a total of 11.4 miles to the Santa Ana Freeway from Rosecrans Avenue about one mile southeasterly of Norwalk in Los Angeles County to Miraflores in Orange County.

This represents the first extension of the Santa Ana Freeway into Orange County. Construction is along the present alignment of U. S. Highway 101 Alternate (Manchester Boulevard), which is the principal route from Los Angeles into Orange County and also is a main highway to the coast cities and San Diego. The present three-lane road paved 30 feet wide was built in 1935. The increase in volume of traffic in the past 10 years, including a large proportion of heavy trucking, has resulted in overcrowding of the existing facility.

First of Three Projects

The first of these three projects extends from Rosecrans Avenue to the Los Angeles-Orange County line, a distance of approximately 3.5 miles. This job consists of construction of a new two-lane roadway of asphalt concrete on plant-mixed cement-treated base on the southerly side and adjacent to Manchester Boulevard to provide a four-lane divided limited access freeway. The new roadway will be the eastbound portion of the freeway and westbound traffic will be carried by the existing pavement. Outer highways of plant-mixed surfacing on untreated rock base are being constructed on each side of the freeway throughout the length of the project. Traffic will be allowed to cross the freeway at three intersections, Carmenita Street, Alondra Boulevard and Valley View Road, all of which will be controlled by traffic-actuated signals installed under a separate contract.

Three New Bridges

It was necessary to construct three new bridges to carry the eastbound roadway and the two outer highways over Coyote Creek about 1,500 feet westerly of the Los Angeles County line. These bridges are of the reinforced concrete slab type. The timber spans of the approaches to the existing bridge were removed and replaced with reinforced concrete spans. Construction on these bridges is virtually completed at the present time.

This contract was approved by the Attorney General on January 13, 1950, and the contractor began work on January 16, 1950. The work is more than 50 percent completed at present. Contractor on the project is Peter Kiewit Sons' Co. of Omaha, Nebraska, with T. H. Kelly as superintendent. The contract allotment is $715,700.

Second Project

The second of the three projects extends from the Los Angeles-Orange County line to Euclid Avenue in Orange County, a distance of approximately five miles. The project is, briefly, a new two-lane roadway of asphalt concrete on cement-treated base, the existing roadbed widened with asphalt concrete on cement-treated base and portions of the existing pavement resurfaced with asphalt concrete and plant-mixed surfacing. Shoulders are to be constructed of untreated rock surfacing and bituminous surface treatment applied, and outer highways constructed to provide a four-lane divided highway.

The entire project follows the existing alignment of Manchester Boulevard. From the Orange County line to the Fullerton Creek bridge, approximately 1.6 miles, the new construction will carry the eastbound traffic and the existing roadway will carry the westbound traffic. From the Fullerton Creek bridge to the end of the project,

Looking southeasterly showing construction under way through Bueno Park

UPPER—Looking northwesterly showing construction under way near Miraflores in Orange County. LOWER—Looking northwesterly showing construction under way near county line

the existing Manchester Boulevard will be the eastbound roadway and the new construction will be the westbound roadway. An existing reinforced concrete bridge across Fullerton Creek has been widened to accommodate the new roadway.

The second contract, for which the allotment is $516,900, was approved by the Attorney General on April 12, 1950, and work was started the same day by Sully-Miller Contracting Company, the successful bidder. Work was rather slow the first month due to right of way clearance and the development of a new borrow pit on the Sunny Hills Ranch about one mile west of Fullerton by the contractor. However, construction is moving rapidly now and the project is more than 60 percent complete at the time of this writing. F. L. White is the job superintendent for the contractor.

Not Ultimate Freeway

The first 1.6 miles of this project from the Los Angeles County line to a point easterly of Buena Park is an improvement to the existing roadway and is not the ultimate freeway. The ultimate freeway within these limits will by-pass the Buena Park business houses fronting on Manchester Boulevard by another alignment, thus improving local traffic conditions as well as expediting through traffic.

On the freeway portion of the work, traffic will be allowed to cross the freeway at five intersections, Artesia Avenue, Orangethorpe Avenue, Magnolia Avenue, La Palma Avenue and Euclid Avenue. These intersections will be controlled by traffic-actuated signals installed under a separate contract.

The third contract, for which the allotment is $330,500, was awarded to the Griffith Company of Los Angeles, and approved by the Attorney General on April 13, 1950. Work on the project was started April 25, with J. F. Porcher as superintendent for the contractor until June 1st when T. W. Oglesby was placed in charge and Mr. Porcher was assigned to another project. The work is now over 50 percent complete at the present time. Construction work progressed fast until right of way complications were encountered in the way

. . . Continued on page 62

Cuesta Grade

Freeway Is Completed on Tortuous Section of U. S. 101

By E. J. L. PETERSON, District Engineer

LAST REMNANT of the once steep and tortuous Cuesta Grade has been obliterated by four-lane divided freeway construction recently completed on the Coast Highway, U. S. 101, in San Luis Obispo County between Cuesta Siding and one mile south of Santa Margarita.

This modern improvement is a marked transition from the primeval trail used by Franciscan Fathers, Spanish courtiers and brigands to cross the Santa Lucia Mountains through the Cuesta Pass. The first road over the pass came into being about the turn of the nineteenth century as a result of the Padres widening the foot and hoof carved trail so that it might be negotiated by wagons. In 1850, the Court of Sessions spent $1,000 improving the road, and in 1876, a road, modern for those time, was provided by the issuance of $20,000 in bonds.

Early Day Problem

On formation of the California Highway Commission in 1912, one of the first problems presented was that of providing a road through the pass which could be traversed without undue difficulty by the forerunners of the present-day automobiles and trucks. Surveys were immediately undertaken from San Luis Obispo to Santa Margarita. The first project for grading a 24-foot width roadbed and paving a 15-foot width with a 4-inch thickness of Portland cement concrete on portions of both approaches to Cuesta Pass was advertised, with bids received on October 30, 1913. On failure to receive acceptable bids the work was accomplished by day labor. Construction of the intervening portion over the pass was let to contract in 1914.

In 1929, this section of highway was reconstructed to a 36-foot width graded roadbed and a Portland cement concrete pavement 20-feet in width and 9 inches-6 inches-6 inches-9 inches in section.

Initial Project

The initial project looking toward development of Cuesta Grade into a highway adequate for present day traffic was accomplished in 1937-38, when the portion between San Luis Obispo Creek and Cuesta Siding was reconstructed to provide a four-lane divided roadbed. (Described in July, 1936; January, 1937; and May, 1938, issues of this magazine). Rights of way for this section were not acquired on a limited access basis as is being done at the present time on main highways, having been purchased prior to initiation of this procedure. However, the precipitous nature of the terrain limits access to effect a limited freeway. In

View looking southerly toward Cuesta Pass

New lanes constructed for southbound traffic on left. North bound traffic carried by resurfaced existing roadbed on right

1948, reconstruction of the portion from San Luis Obispo to San Luis Obispo Creek to a four-lane divided freeway was completed. (Described in September-October, 1948, issue of this magazine.)

With completion of the present reconstruction of the section from Cuesta Siding to one mile south of Santa Margarita, a four-lane divided limited freeway is provided throughout the entire length of Cuesta Grade.

Natural Landscaping

Terrain traversed by the project just completed made it advantageous to differentiate the grade line of the new two lanes from that of existing roadbed and to provide a variable width of median strip. These features and preservation of many large sycamore and oak trees serve to afford natural landscaping in keeping with the adjacent heavily wooded mountains. Only those trees of the abundant growth falling within the traffic lanes and shoulders or which were so close to the traffic lanes as to constitute a potential hazard to traffic were removed.

Throughout an appreciable portion of the project it was necessary to provide a new channel for Santa Margarita Creek. Confines of the canyon dictated that the channel be in close proximity to the roadbed. Sacked concrete riprap was constructed along the channel at critical locations to obviate erosion while broken concrete pavement was placed on the channel slopes as protection where it was anticipated that only moderate erosion might occur. Runoff from early rains indicated that portions of the channel bottom would be subject to excessive cutting. On these portions of the channel check dams were constructed of broken concrete to retard the stream velocity.

Exact Planning

Portions of the 24-inch concrete cylinder pipe line, aggregating 2,200 lineal feet in length, which is a part of the system that transmits water from the Salinas Reservoir east of Santa Margarita through the Santa Lucia Mountains to the City of San Luis Obispo fell within the limits of construction. Exigency of keeping the length of time the pipe line was out of service to a minimum, and to less than 24 hours during any one period, required exact planning and coordination of the work of installing and connecting the new sections of pipe line.

Basement soils throughout the project are of poor quality, having resistance values of 43 or less with a prevailing range of from 20 to 30, requiring a total base and surfacing thickness of 24 inches to carry the anticipated 5,000 pound equivalent wheel loads. A subbase of material having a bearing ratio at 0.1 inch penetration of not less than 60 percent and a plasticity index of not more than six was placed to a 1-foot minimum thickness, except where new surfacing was underlain by existing pavement.

Construction Design

Surfacing is composed of a 4-inch thickness of plant-mixed surfacing over an 8-inch thickness of imported base material, except where placed on existing pavement the base material has a minimum thickness of six inches. The upper four inches of imported base material was stabilized by mixing it with 1.8 percent of Portland cement to increase its supporting value. Tests indicated that addition of this small percentage of cement increased the resistance value of the material from an average of 72 to an average of 80, and the average California Bearing Ratio

. . . Continued on page 27

An Experiment

Successful Tests in Reworking Pavement Foundations Are Made

By EARL WHITHYCOMBE, Assistant State Highway Engineer

THE UNEXPECTED increases in traffic and the rapidly mounting axle load repetitions of maximum intensities that have taken place in recent years make it necessary to rework and strengthen many miles of pavement foundations that were not designed for such usage. Reworking of the base with the addition of cement to overcome plasticity and to impart a limited amount of slab strength has been the generally accepted practice. This work has been highly successful; however, it has been expensive due to the fact that the existing bituminous surfacing had to be broken up and incorporated into the base solely for the lack of a method of salvaging. New surfacing was necessary after the base had been corrected.

The Shell Oil Company recently developed an aromatic solvent that it has been marketing as an asphalt softener. This material seemed to hold promise in the reworking and salvaging of bituminous pavements. As an experiment to determine if this material could be used successfully to reclaim surfaces where base failures made reworking necessary, it was decided to make a full-scale field test to determine the practicability of the method and to develop the technique of handling such work.

Failing bituminous surfaces of all descriptions were considered for the test and it was finally decided to attempt to rework a section of asphalt concrete on Yolo 6 C, known as the Davis Highway, just west of the junction with Route 99 to Rio Vista. This pavement was laid in 1936 using 50-60 penetration asphalt as a binder and was an extremely tough and hard pavement that had commenced to break up into slabs of small area due to structural failure.

The principal reason for selecting this section for the experiment was the extremely difficult task of breaking up the pavement due to the nature of the mixture. It was acknowledged that successful reworking of this section would insure that anything on the State Highway System could be handled similarly.

Commission Gives Authority

Authorization for the project by day labor was obtained by vote of the Highway Commission on June 21, 1950. C. A. Neville, local representative of Gardner Mixers, Inc., did the work of lining up the equipment owners who successfully bid in the rental of the equipment on a service

Gridroller and tractor pulverizing and motor grader sizing windrow for Athey loader. Athey loader and crusher operating, extreme right. Note windrow of material crushed by Athey in right foreground

agreement. The equipment was rented fully operated. Work was commenced July 10th and completed August 17, 1950. The work was carried out under the supervision of C. H. Whitmore, District Engineer, and directed by R. E. Biggs, Resident Engineer.

The asphalt concrete was broken up by a Caterpillar D-8 tractor and LeTourneau heavy-duty rooter fitted with three teeth. Laboratory tests on the recovered asphalt in the mix indicated the penetration was down to 25 and the rip-up was most difficult as is illustrated in the accompanying photograph. The average depth of the pavement was approximately 8½ inches and some 1,825 tons were broken up and processed.

Chunks Broken Up

Following the original rooting, a Hyster grid roller loaded to 28,000 pounds was towed behind the D-8 to break the large chunks down to crusher size. Due to the depth of material it was necessary after a few passes to bring the large chunks up from the bottom so that the rolling would be effective. A hitch was welded to the back of the rooter and the grid roller was then towed behind the rooter and drawn by the tractor. This combination worked admirable well in breaking down the chunks to 8 or 10 inches in diameter.

Breaking the mixture down to proper size for road-mixing operations was performed by an Athey Model 3 force feed loader towing an Athey Model PB-3 portable breaker. This proved to be an indispensable tool to reduce the aggregate to a uniform size. The Athey operations created somewhat of a dust nuisance, but this was overcome by applying a small amount of water to the windrow in advance of the crushing. This equipment would readily handle a 1½-cubic-foot windrow in this type of material at a speed of one mile per hour.

Asphalt Softener

The asphalt softener was introduced through a Gardner mixer. The extraction tests on the pavement mixture showed 6½ to 7 percent of 25 penetration asphalt and 11 to 12 percent of material passing the 200-mesh sieve.

UPPER—Newly scarified pavement. LOWER—Texture of finished pavement. Average depth of pavement was approximately 8½ inches and about 1,825 tons were broken up and processed

Applying asphalt softener through Gardner mixer

The Shell Oil Company recommended 1.3 to 1.4 percent of softener and 1.35 percent was added in two applications 24 hours apart to the first section treated. This appeared visually to be too much and was reduced progressively until finally 0.8 to 0.9 percent was all that was being added.

A three-inch lift of the mixture with 1.35 percent of softener was laid out for traffic over one weekend. This resulted in a complete failure from excessive corrugations. Stabilometer determinations disclosed a stability of 35 percent for the pavement when first broken and crushed, 20 to 25 percent immediately after the softener was added and 5 to 7 percent 48 hours after adding the softener. Thirty-five percent is considered a desirable stability for a bituminous mixture.

Stability Increased

Laboratory tests were then made on the softened mixture with the addition of dry material and it was found that 33 percent of five-sixteenths inch by No. 8 screenings increased the stability to 36 percent. This percentage was added to all but one section 1,000 feet in length where dry sand from the subgrade was incorporated into the mixture and the resulting stability was satisfactory. The added screenings did not readily coat with bituminous binder and at the time of laying the mixture, the added screenings remained probably 75 percent uncoated but fairly well distributed and the results are entirely satisfactory. No pitting has taken place and the surface is uniform in appearance.

Difficulty was experienced with one section of subgrade due to the material being a loose sand. The condition of the undisturbed asphalt concrete pavement on this particular section was the poorest of all that was reworked and cement treatment of the subgrade with 5 percent of cement by weight was decided upon. The cement was spread by hand from sacks on the windrow and the mixing was performed with the Gardner. Having the reconditioned and salvaged mix in a windrow alongside eliminated the necessity of applying a curing seal to the cement-treated base. One inch of the bituminous mixture was spread immediately after the base was compacted.

Construction Procedure

Single-lane tear-up is practical by deeply scoring the pavement surface in advance with one tooth on a 12-foot grader as a line to break to.

It was found that the rooting operation was most satisfactorily performed during the heat of the day. The breakage into smaller sizes was improved.

Breaking down to crusher size with tractor, rooter, and grid roller should follow immediately behind the rooting operation.

Crushing was best accomplished at lowest temperatures and was made the first operation in the day.

The introduction of the softener and the mixing and aerating were all performed by means of the Gardner mixer. It was found that the mixing and aeration were best performed in the heat of the day and was therefore confined to the afternoon.

The layout was accomplished with a 12-foot motor grader in the manner specified for road-mixed surfacing.

Compaction was obtained on the lower courses by means of the grid roller with the counterweights removed. The top course was compacted

by means of a steel-tired eight-ton tandem roller.

Costs Surprisingly Low

Due to the nature of the work, the limited quantity involved, necessarily short runs for the equipment, excessive standby of men and equipment waiting for the completion of a prior operation and the wasted work necessary to develop successful procedure on an untried process, the unit costs were expected to be excessive. The final costs of breaking up, mixing and re-laying, including all added materials, amounted to $4.62 per ton of mixture, which is considered surprisingly low under the circumstances. This cost represents about the current price of new mix replacement.

We firmly believe that on a sizable project by contract these costs can be reduced to the extent that salvaging bituminous pavements will be a very profitable procedure for the owner.

Results Attained

The experimental section has been under traffic for two months carrying an average of 17,000 vehicles per day and is in excellent condition. The surface texture is granular and non skid as are most surfaces laid by the blade method. There is no evidence of any flushing of asphalt to the surface and the entire section is free of any indication of distortion. The riding qualities are excellent.

Sufficient funds were provided in the work order to apply a seal coat to this reworked mixture. Due to the satisfactory appearance at the time of completion, the seal coat was deferred. Now that the pavement has gone through considerable rainfall without any distress whatever, the seal coating has been abandoned and the funds reverted.

In all physical respects the work has been highly successful.

View showing variation in width of median and between grading lines of two sets of lanes. Santa Lucia Mountains in background

Cuesta Grade

Continued from page 23 . . .

at 0.1 inch penetration from 163 percent to 278 percent.

Each set of traffic lanes is 24 feet in width with a 2-foot surfaced border along the inside edge and a 3-foot surfaced border along the outer edge. A seal coat with fine screening cover applied to the traffic lanes serves to demarcate them.

Construction Items

Principal construction items on the project included 110,000 cubic yards of roadway excavation; 32,100 cubic yards of ditch and channel excavation; 10,400 cubic yards of structure excavation; 51,700 tons of imported subbase material; 27,260 tons imported base material; 12,900 tons imported base material (cement stabilized); 1,200 barrels of Portland cement (cement stabilization); 18,800 tons plant-mixed surfacing; 510 cubic yards of Portland cement concrete (structures); 82,300 pounds bar reinforcing steel; and 2,200 lineal feet of 24 inch concrete cylinder pipe.

The firm of Granite Construction Company was contractor on the project with Mr. V. E. Pearson of the Division of Highways as Resident Engineer.

Access to Alpine

Pioneer Road Construction On a 1950 Highway Project

By J. H. CREED, Design Engineer, District IX

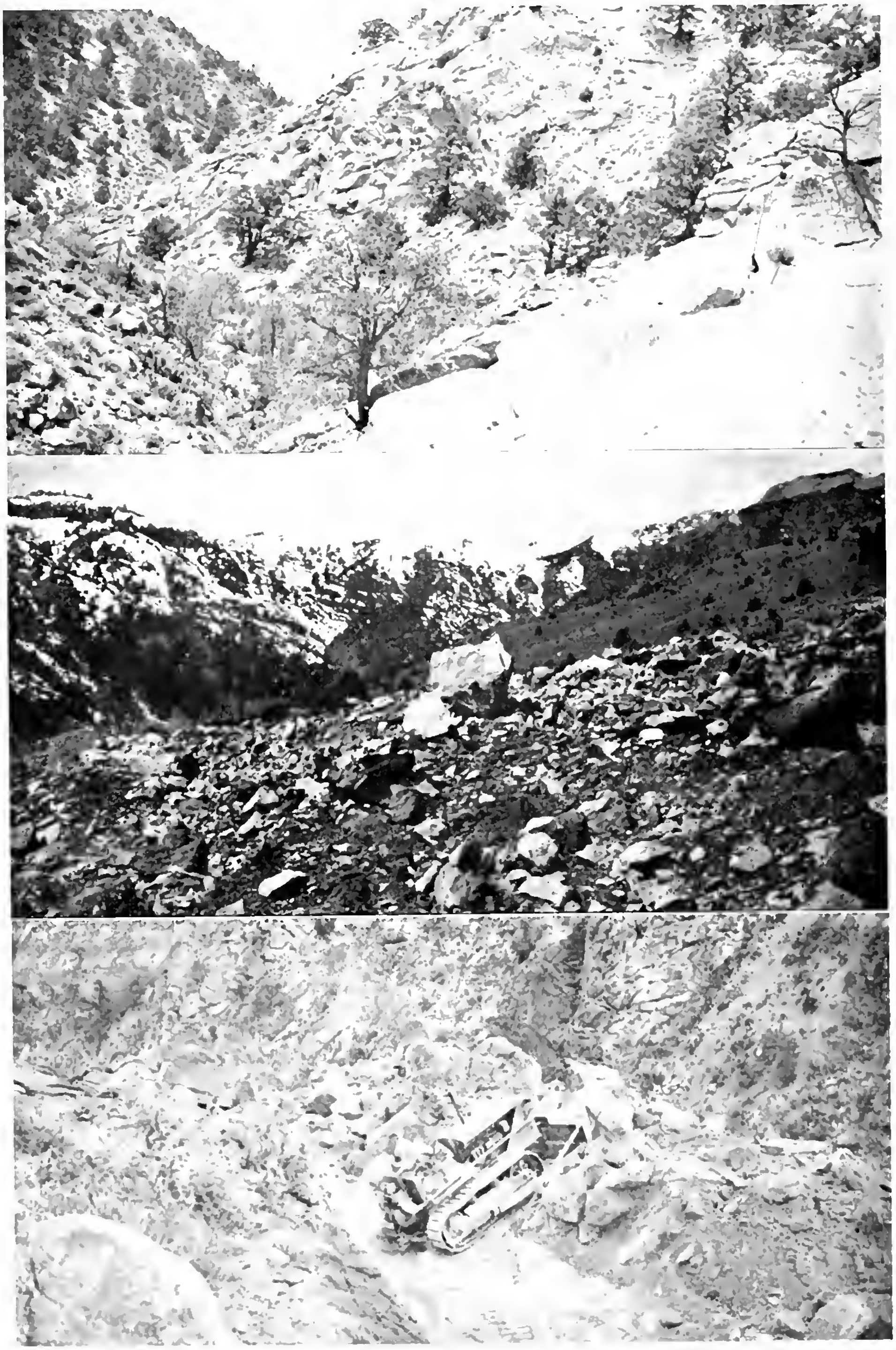
With the present road system in California developed as it is, nearly all the road work consists in bringing existing roads up to modern standards, rather than constructing new roads on virgin alignment. An exception to this trend is the route now under construction in Alpine and Mono Counties, connecting U. S. 395 near Topaz, and the Ebbetts Pass highway about five miles west of Markleeville. It is being constructed jointly by Alpine and Mono Counties as a Federal Aid Secondary Project. Technical assistance is being given by the State Division of Highways, but the route is a county highway, and not in the state system.

For many years there has been considerable pressure to have a connection made at or near this location. At present the only access to Alpine County and Lake Tahoe from the south is through Minden, Nevada, more than 20 miles out of the way.

Forest Service Starts Work

The first start on the new construction was made by the Forest Service which constructed about one-half mile of road up Slinkard Canyon from U. S. 395. In 1947 Mono County contracted with a consulting engineer to make a survey from Heenan Lake to the end of the Forest Service road in Slinkard Canyon, a distance of 15 miles over virgin country. The only access was by foot or horseback, and much working time was lost getting to the job and back. The daily rodeo of getting the survey party off was quite a local attraction for some time.

This contract produced a stadia, preliminary line on which, in part, a construction centerline was laid from Heenan Lake to the Alpine-Mono county line. In the summer of 1949 a contract for grading was pushed through to completion on this part of the route. The engineering work on this portion was handled by the Alpine County Road Department, under the



UPPER—Looking west up Slinkard Canyon before blasting. CENTER—After shooting boulders. LOWER—'Dozer moving rock after shooting

direction of N. H. Kearns, County Road Commissioner. The contract covered grading, drainage, and imported base, but no oiling.

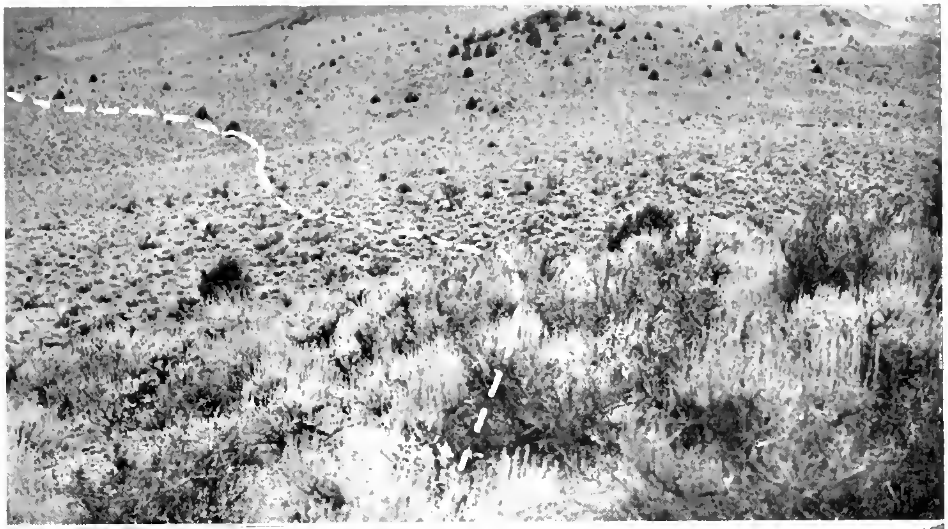
Transportation Problem

In the summer of 1949 a located line was run four miles in from the end of the Forest Service road from U. S. 395. This work was also plagued with the transportation problem, and at the last a camp was set up near the end of the line. This saved about four hours walking time daily for the survey party. Survey and design work was done by District IX forces.

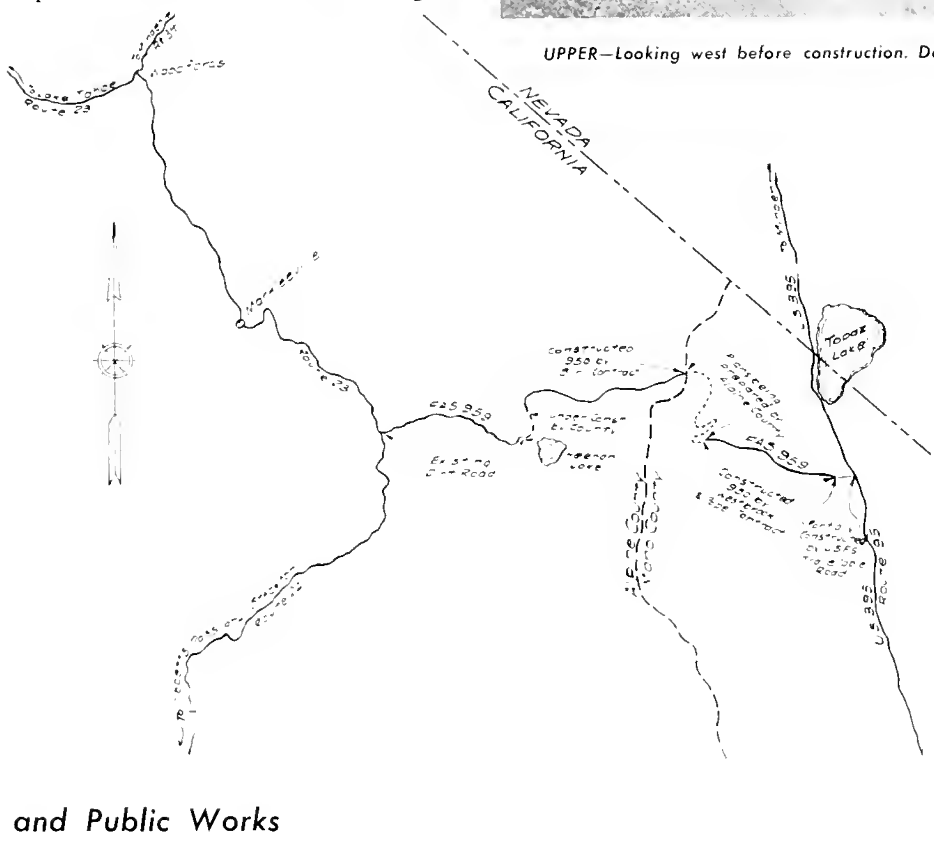
This section went to contract for grading and drainage in January, 1950, and was completed in the middle of the summer.

The connecting section of three and one-half miles comprises rather difficult location and construction up a steep mountain side. The location and design is being done by the Alpine County Road Department, and it is anticipated that this section will go to contract this winter with the work completed some time next summer.

This will make a travelable road across the mountain. However, the existing road from Heenan Lake to the Ebbetts Pass Highway will have to be improved to make it a standard light traffic mountain highway, and the entire route will have to be surfaced. When these things are done, access to Alpine County will be opened up from the south without the necessity of "detouring" through the State of Nevada.



UPPER—Looking west before construction. Dotted line shows route. LOWER—After construction



The construction from Heenan Lake to the Mono County Line was done by Arthur B. Siri, contractor, under the supervision of the Alpine County Road Department. The section up Slinkard Canyon was done by Westbrook and Pope, contractors, under the supervision of District IX, with S. W. Lowden, District Engineer *; J. Dekema, District Construction Engineer; and G. J. Snyder, Resident Engineer. Combined cost of the two contracts was in excess of $200,000.

* *Mr. Lowden now is District Engineer of District VIII with headquarters at San Bernardino.*

Piru Gorge

Spectacular Blasting Required on Ridge Route Project

By C. J. McCULLOUGH, Associate Highway Engineer, Resident Engineer

COMPLETION of four state highway projects on U. S. 99, now under construction, will provide a four-lane divided highway from Pico Canyon 85 miles over the Ridge Route to Bakersfield. The projects now being constructed are located at Castaic, for a length of 5.1 miles, through Piru Gorge, 5.3 miles, Holland Summit through Lebec 11 miles, and a contract at Greenville south of Bakersfield.

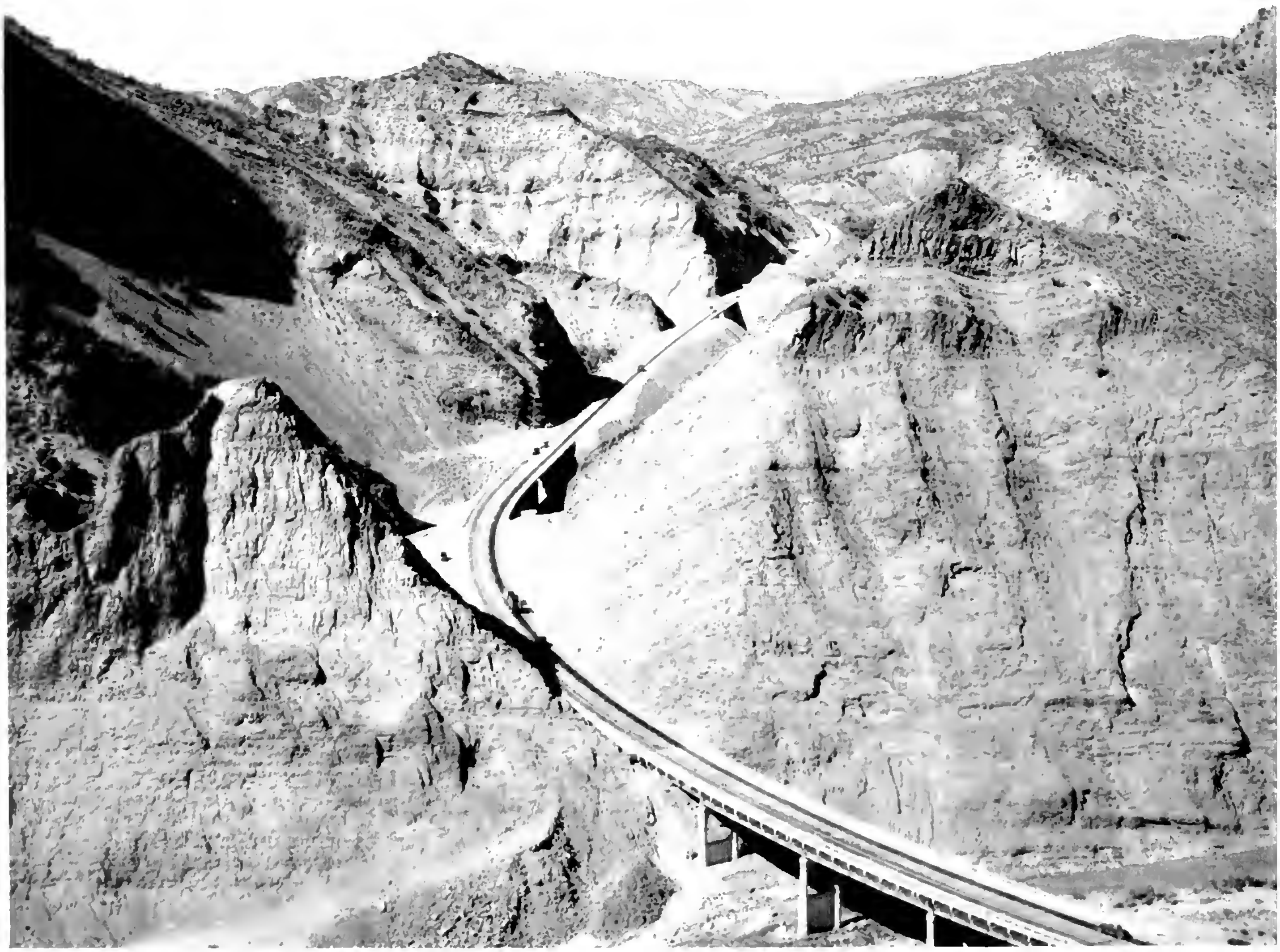
Probably the most difficult of these projects is the Piru Gorge section, extending from Frenchmans Flat northward to connect with the divided highway just north of the State Maintenance Station.

Huge Excavation Job

Awarded to A. Teichert and Sons, of Sacramento, this contract involves roadway excavation in the amount of 1,100,000 cubic yards, overhaul amounting to 15,000,000 station yards, the construction of two concrete bridges across Alamos Creek and the widening of the existing bridge across Piru Creek at Frenchmans Flat.

The contractor will set up a crushing plant at the state-owned quarry site several miles north of the northerly end of the contract, for the production of 192,000 tons of base material

This is U. S. 99 through Piru Gorge on the Ridge Route which is being widened to a four-lane divided highway



Blasting in Pyramid Cut in Piru Gorge. Left to right—Powder is in place in 350 holes in this cliff. Blast has just been set off. Blast eruption at its height. Huge smoke clouds begin to settle. The highway was closed for only 42 minutes before, during and after the blast when bulldozers cleared the roadway for traffic

and 45,000 tons of aggregate for plant-mix paving.

The 40,000 cubic yards of selected rock for the protection of fill slopes will be obtained from the rock cut just south of Pyramid Cut.

Existing drainage structures, concrete box culverts and corrugated metal pipes are to be extended through the widened roadway and additional drainage installed.

Division of Traffic

The division of the traffic is accomplished over a portion of the distance by an unpaved dividing strip 8 feet wide. Over a slightly longer section the pavement is continuous for the full width of the roadway and a 6-foot dividing strip consisting of raised bars separates traffic.

Where the unpaved dividing strip provides two separate pavements, these pavements are each 24 feet wide, with 3-foot and 2-foot paved borders, with penetration-treated shoulders 5 feet and 3 feet wide.

Where the dividing strip consists of raised bars, the pavement decreases from a width of 78 feet in cut sections to 72 feet over fills.

All pavement is plant mix, supported by eight inches of untreated rock base over eight inches of imported subbase.

Spectacular Work

The most spectacular work in connection with this contract is the widening of Pyramid Cut to provide an additional roadway and a new channel for Piru Creek parallel to and below the roadway. This channel will obviate the necessity for two bridges across Piru Creek. The two existing bridges will be removed and replaced with a fill and the salvaged steel girders used in the bridges across Alamos Creek.

To get the pioneering equipment to the top of the cut, it was necessary to work the bulldozers in from Reservoir Summit on the old Ridge Road. This equipment then graded a circuitous and rather precipitous trail down into the bed of Piru Creek.

Considerable time was consumed in grading a bench at the peak of the cut 310 feet above the grade of the channel to provide room for drilling operations. The cut has been brought down about 100 feet and sufficient working area secured to allow room for a large drilling crew.

Rock Loosened by Blasts

The drilling is done to a depth of 24 feet. Using low strength powder, the laminated rock is loosened for a depth of 30 feet at each round of shooting. By using a heavy rooter the material is further loosened so that it can be shoved over either end of the cut, from where it is loaded into Euclid trucks and hauled to the grade.

A birdseye view of the Piru Gorge, as shown in the accompanying photograph shows quite clearly the rugged nature of this location.

When one views the steep high slopes rising above the narrow roadway and realizes that 70 percent of the 1,100,000 cubic yards of rock slate and shale to be moved comes from the 4,000 feet of roadway shown in the picture and near vicinity, he will appreciate the difficulty of maintaining traffic while grading is in progress. This problem is uppermost in the minds of those in charge of the work and always is the chief consideration in all plans of procedure.

Detour Provided

Large signs have been placed on San Fernando Road at Tunnel Station and at Gorman warning motorists of possible delays of from 15 to 45 minutes and stating that the construction zone may be detoured by way of Lancaster.

In widening the high steep cuts through the Gorge section, the pioneering work must necessarily start at the top. This material is shoved over the cut slope to the roadway beneath. While this material is being worked down from the slope, traffic is stopped. The bulldozers shove down material for 10 minutes, then a tractor cleans off the pavement and the waiting traffic is allowed to proceed.

When the loose material has accumulated to a point where it is encroaching on roadway width, it is moved by shovel and trucks. It is at times necessary to control traffic past shovel operations.

Dust Clouds

When these sliver cuts are brought down to a point where there is a bench of sufficient width to use scrapers, traffic may pass without interference.

. . . Continued on page 43

Time Takes Steady Retirement Toll Amon

Wm. F. Faustman

Another "old-timer" in state highway work will soon join the ranks of engineers who have recently left active work for the more leisurely role of

WILLIAM F. FAUSTMAN

retired veterans in Sacramento. William F. (Bill) Faustman, Associate Highway Engineer in the Construction Department, will leave on January 1, 1951, after 39 years of service with the State.

"Bill" came to California from New York in 1907, soon after graduation from Cornell University in civil engineering. His first job was with the former Peoples Water Co., of Oakland (now East Bay Municipal Utility District), engaged in experimental filtration work. This was followed by work with the City of Oakland. In 1908, he

. . . Continued on page 35

J. M. Hollister

On August 22, 1950, J. M. Hollister retired after 27 years of faithful service as Resident Engineer with the Division of Highways. He was born in Kuna,

J. M. HOLLISTER

Idaho, July 16, 1887. He received his formal education and extensive construction and paving experience in the City of Boise, Idaho. He served with the A. E. F. Army Engineers in France during World War I. He began work with the Division of Highways in District V in 1923, and after two years transferred to District VIII where he was employed until the time of retirement.

Joe, as he was affectionately known by his many friends, was a construction man of the old school. Even though he had a background in early paving tech-

. . . Continued on page 34

JAMES G

Known to hundreds of employees of the Division of Highways who were processed through his office to civil service positions, Assistant State Highway Engineer James G. "Jim" Standley

JAMES G. STANDLEY—1914

retired on October 1st after 36 years of service with the division.

Jim Standley, fresh from the University of Missouri, worked for the Santa Fe Railroad in Kansas from August, 1910, to August, 1914, as instrumentman. He then came to California and began work with the division in August, 1914, as a junior civil engineer in District II, which then had its headquarters at Dunsmuir. From July, 1915, until early 1919 he was chief draftsman in the district office. He then became office engineer, a position he held until June, 1923, when he was promoted to assistant division engineer.

When Standley reported to Dunsmuir as the first man to be appointed from the newly created civil service

Veterans of Department of Public Works

TANDLEY

list, there were 10 people employed there in the office of T. A. Bedford, then division engineer.

Of those early days, R. H. Stalnaker, recently retired as equipment engineer,

JAMES G. STANDLEY—1950

and who then was assistant division engineer at Dunsmuir, relates:

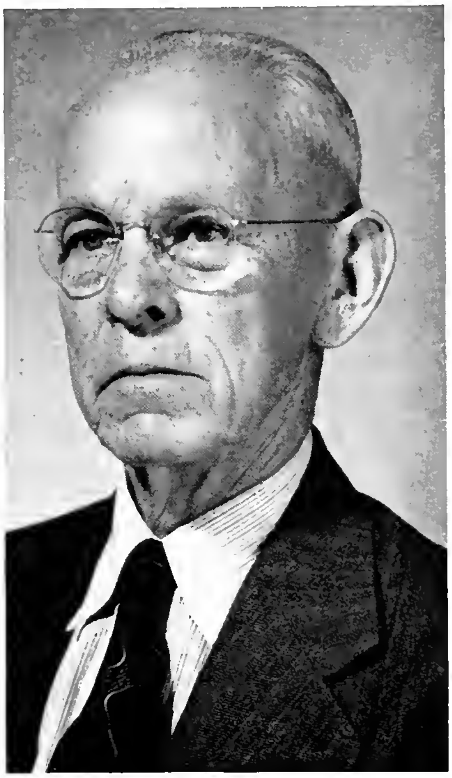
"Young Standley was a hustler, an earnest and hard working young engineer, and advanced rapidly. Our headquarters office then was on the upper floor of a private residence on Butterfly Avenue. In 1915 we moved into two small residential houses. We were snowed in four or five months every year and during the winter months took our vacations or worked on surveys and plans prepared during the previous summer. In good weather it took us all day to drive from Dunsmuir to Redding, to which the district offices were later transferred. Jim Standley saw the California Highway System

. . . Continued on page 53

Chas. O. Palm

Chas. O. Palm retired voluntarily from state service on August 31, 1950, at the age of 67.

Mr. Palm entered state service on



CHARLES O. PALM

July 13, 1911, as a clerk with the Division of Architecture in Sacramento. He advanced to the position of supervising account clerk in 1931, which position he held at the time of retirement.

He was in charge of the clerical staff of the division, involving pay rolls, civil service, office supplies, inventory, automobiles, invoices, and office services.

He served 39 years of continuous service with the State, six years with the Purchasing Department and 33 years with the Division of Architecture.

The Montgomerys

On September 28, 1950, a testimonial banquet was given at the Hotel Whitcomb in San Francisco for Mr. and Mrs. Z. J. Montgomery of the

Z. J. MONTGOMERY

Division of Architecture, honoring them on their retirement after 30 years of service with the State. The banquet was arranged by the state employees of District No. III; T. T. Thompson, chairman.

Three hundred friends of Mr. and Mrs. Montgomery attended the banquet.

W. K. Daniels, Assistant State Architect, introduced Joe O'Sullivan, Master of Ceremonies. The speakers for the evening were: Carl Henderlong, Division of Architecture; Dan Mac-

Speakers table at banquet given to Mr. and Mrs. Z. J. Montgomery. Left to right, Mrs. Montgomery, Mr. Montgomery, Joe O'Sullivan, master of ceremonies, Deputy Director of Public Works Frank B. Durkee, Mrs. W. K. Daniels, Dr. Walter Rapaport, Superintendent, Agnews State Hospital

Donald, Pacific Coast Representative of Plumbers and Steamfitters; Lawerence Hobart, State Purchasing Agent; James Ricketts, Manager of the Golden Gate Bridge; E. S. Thompson, Controller of San Jose State College; J. W. Peters, Contractor; Frank B. Durkee, Deputy Director of Public Works; M. F. Small, Secretary to Governor Earl Warren; J. W. Montgomery, Attorney, son of the honored guests; Anson Boyd, State Architect.

Montgomery was employed by the State as Foreman of Construction in 1920, and he supervised the construction of many buildings at the Mendocino State Hospital. In 1930 he was transferred to District III, which is known as the San Francisco Bay District, comprising San Francisco, Alameda, Contra Costa, San Mateo, Santa Clara, San Benito, Santa Cruz, and Monterey Counties. He advanced to District Construction Supervisor when he took over supervision of District III.

Montgomery supervised the construction of many state buildings, but he is particularly proud of having supervised the construction of Langley Porter Clinic in San Francisco, the Highway District IV Office Building in San Francisco, the Cow Palace in San Mateo County, and the starting of the Medium Security Prison at Soledad.

From 1926 to their retirement date, Mrs. Montgomery acted as office manager to Mr. Montgomery, and he states that 85 percent of the credit for the work accomplished by him belongs to her.

J. M. Hollister

Continued from page 32 . . .

niques, he was always receptive and eager operating under new-fangled ideas. He is especially popular with the many men who have worked under his direction, and he conservatively estimates that he has "trained" enough young college graduate engineers to staff construction organizations of several districts.

Clifford M. Weber

Clifford M. Weber, 30 years in charge of the construction work of the Division of Architecture in the Los Angeles area, retired from active state service on April 15, 1950. "Web" had been an employee of the division for 38 years, excluding a brief period of illness in 1916, and service in World War I in 1917 and 1918.

CLIFFORD M. WEBER

Weber was a third generation Californian, both he and his father being natives of Nevada County. He was born at Nevada City, California, on January 15, 1888. Weber's mother, a native of England, was a naturalized American. He received his education in the public schools of Nevada County and extension work through I. C. S. courses.

He began his career in the construction field in San Francisco. In the winter of 1912, he went to work for the Architectural Division of the Department of Engineering. His first work was at Santa Barbara State College un-

der Reilly McNeill, who was the project mechanical engineer. He afterwards worked in San Francisco on the construction of the fairgrounds there and in 1915 was appointed to the Division of Architecture crew at Folsom State Prison, under the supervision of Jack Dutton. Weber was foreman in charge of a crew of both free and inmate labor working on the new granite and concrete cell block.

Served in World Wor I

After a period of illness and recuperation in Nevada, Weber entered the Army during the first World War. Upon his discharge after the war, he returned to the Division of Architecture at Stockton State Hospital where he worked under the supervision of Construction Supervisor, Oliver Morton.

Weber was sent as Construction Supervisor for the division, to Arcata and began the erection of the first buildings of Humboldt State College, when, in 1920 he was appointed to succeed H. E. Mackey as supervisor in charge of the Division of Architecture work in Southern California.

During his incumbency in this post, he supervised the construction work at Norwalk State Hospital, Fred C. Nelles School for Boys at Whittier, Patton State Hospital at San Bernardino, Pacific Colony at Spadra, State Office Building at Los Angeles, Ventura School for Girls, armories at Santa Barbara, Van Nuys, Burbank, Riverside, San Bernardino, Colton, throughout the Los Angeles metropolitan area, Long Beach, San Pedro, the Institution for Women at Tehachapi, the Vocational Institution at Lancaster, and many others. In particular, the large institution at Camarillo State Hospital, the entire Institution for Men at Chino, and recently, the Division of Highways Office Building on Spring Street in Los Angeles were erected under his supervision. The total amount of building construction which was erected under the direction of C. M. Weber is in excess of $57,540,638 and during this period he supervised more than 2,000 individuals on state forces.

Ernest Evers

On October 1, 1950, after nearly 25 years, Ernest Evers, District VI Office Engineer, retired to a well earned rest.

Mr. Evers was born in Iowa and obtained most of his primary and secondary education in Des Moines. He graduated from the University of California in 1908, specializing in railroad engineering. His collegiate work was interrupted for two years during which he was engaged in location work with the Western Pacific Railroad in Feather River Canyon. Following his graduation, he was employed by the New Mexico Central Railway in the capacities of Transitman and Chief of Party on both location and construction.

Roilrood Locotion Work

In 1909-1910 he was engaged in general city engineering for the City of Albuquerque. The next four years were spent on interurban railway location in Salt River Valley and as Chief Locating Engineer on a projected location for the Albuquerque, Cortez and Salt Lake Railway in Montezuma County, Colorado.

After a brief period of office work on a subdivision near Atascadero, California, in the fall of 1914, he accepted an appointment in District V of the California Division of Highways as Assistant Resident Engineer, later Resident Engineer. Walter C. Howe was District Engineer at that time.

Returns to Californio

He continued, except for nine months, as Resident Engineer on grading and bridges with Santa Barbara County with the Division of Highways until June 5, 1919, when he moved to the State of Washington, where he served the Washington State Highway Department for approximately six years in the capacities of Resident Engineer on grading and P.C.C. paving, District Office Engineer and District Maintenance Engineer. He was later employed in a private engineering firm on location, design and construction on an irrigation project in Fergus County, Montana.

Returning to California in 1929 he joined the Construction Engineering staff of District VI under District Engineer E. E. Wallace. He continued in District VI until October 1, 1950, having served as Resident Engineer, District Maintenance Engineer (18 years) and District Office Engineer. He is an associate member of the American Society of Civil Engineers.

Wm. F. Faustman

Continued from page 32 . . .

came to Sacramento for structural and inspection work with the State Architect for a period of about three years. In 1911, he spent a year in the real estate business, and was married to Berenice E. Smith of Sacramento, in March, 1912.

Mr. Faustman's highway experience began in 1914, continuing for a period of 36 years, and covering field and office work in District III, Bridge Department, Central Office and Construction Department; 1928-1950 being in the latter office, as Associate Engineer. During World War I, he was an engineer with the Bureau of Yards and Docks, Washington, D. C., in 1917. In addition to his highway work, he was an instructor in the Adult Evening School in Sacramento from 1913 to 1942. Mrs. Faustman, who passed away in 1948, was prominent for many years in musical and cultural circles and as a music teacher, at her home in Land Park, 1362 Eighth Avenue. Mr. Faustman has continued to live there, sharing his home with army personnel from Mather Field, in addition to "Traffic," his fox terrier. D. Jackson Faustman, his son, is traffic engineer for the City of Sacramento.

"Bill" has no particular hobbies, with the exception of golf, baseball and other sports, and a healthy interest in music and cultural activities. He has been east to New York and other points several times during recent years, visiting relatives, and contemplates doing some more traveling in the not too distant future.

New Tools, Techniques and Talents Used In 1951 Model Bridge Foundation Studies

By C. H. HARNED, Senior Engineering Geologist

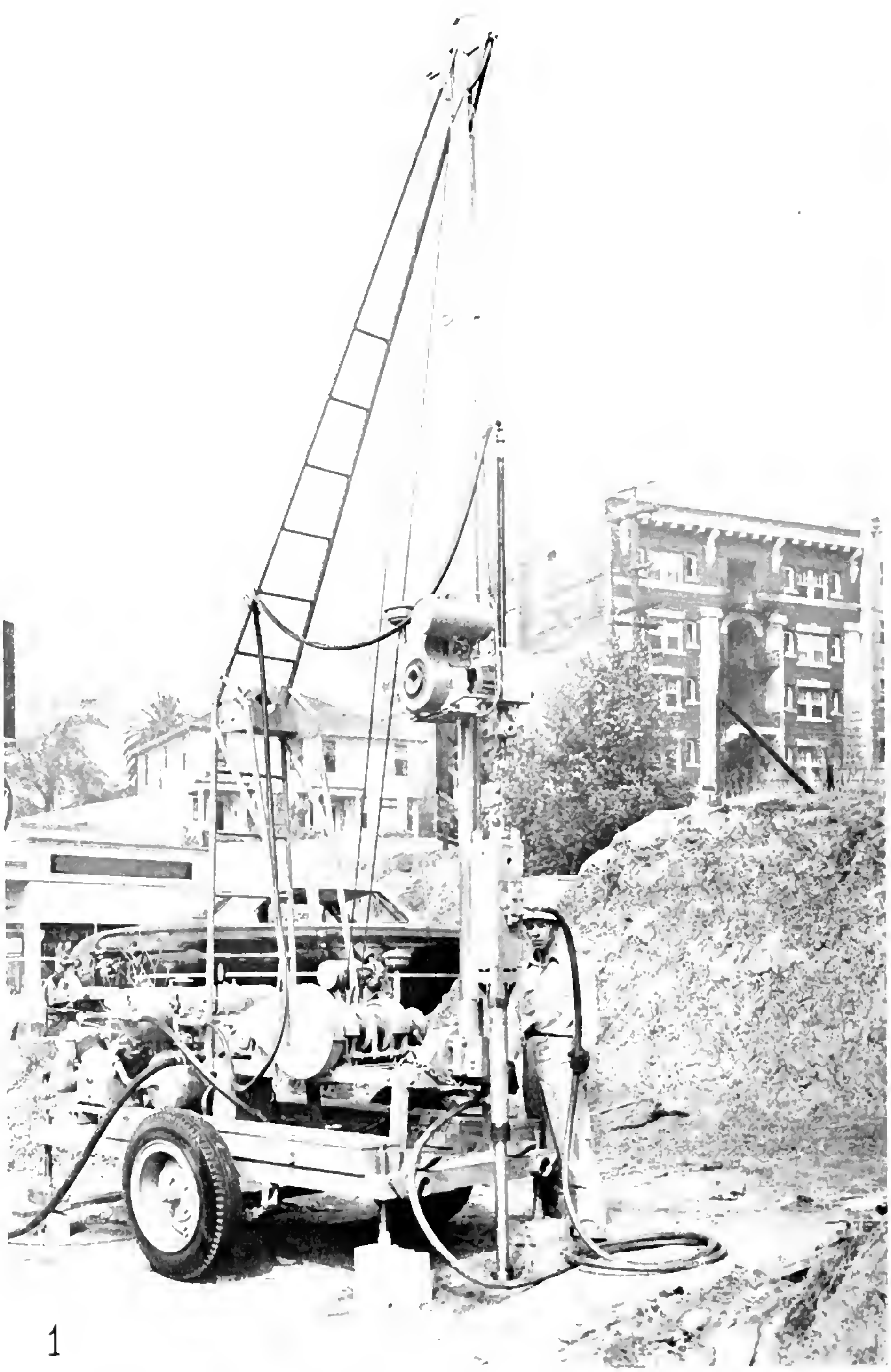
About three years ago the Bridge Department of the California Division of Highways became aware of the necessity of expanding and improving existing facilities for the specific purpose of conducting bridge foundation studies. This decision was, in part, prompted by the rapidly expanding highway program and the enormity of foundation problems anticipated in conjunction with the proposed system of modern freeways but was largely the result of a growing insistence among bridge engineers that large sums of money could be saved if complete and reliable foundation data were available during the design stage.

The "make it stout" complex so prevalent among bridge designers and builders of a few years ago is rapidly being replaced by a healthy and progressive realization that the maximum in bridge foundation economy can result only from the application of structure loads to earth materials in manner and amounts dictated by the nature of the material itself and the minimum safety factor required for good engineering.

Area of Geologic Interest

During the latter part of 1947 the Bridge Department made a study for the purpose of establishing the personnel and equipment requirements for work of this nature. California represents an area of geologic interest and complexity equaled elsewhere on earth only upon rare occasion. Stratigraphic formational units record the geologic history of the State from the Pre-Cambrian dawn days of the earth to the present with but few chapters in omission. The record although known to be exceptionally complete has been so thoroughly scrambled by complex folding, faulting, igneous activity, and other geologic processes that a true and complete interpretation will be a challenge to men forever.

Rotary drill and pneumatic drive hammer



1

In order to obtain tools capable of fulfilling the requirements of troublesome relief, portability, rugged mechanical constructioin, diversity of tool function, and the widest conceivable range of natural foundation conditions, a survey of available equipment was made which clearly indicated that satisfactory tools were not readily available and would therefore have to be designed and built.

Drilling Equipment

The drill rig proper consists of a revamped version of the standard exploration drill built by a Los Angeles drill manufacturing company. It is a skid-mounted, gasoline-engine-powered, rotary type drill (*see Photo 1*). The drill and accessory tools are mounted on a two-wheel trailer and towed behind a truck. The drill was trailer-mounted in preference to the conventional truck mounting since this method of mounting simplified the unloading operation of the drill in those cases in which topographic conditions or inaccessible stream-crossing sites required skidding the rig to the job. The rig is capable of pulling itself along on its steel skids by means of its own power winch and cable. Sufficient power is available to pull the rig up, or lower it, over the face of a vertical cliff should this extreme necessity arise. In addition, the trailer mounting puts the entire drilling operation close to the ground, reduces the height of mast requirement, and eliminates one truck per foundation study unit.

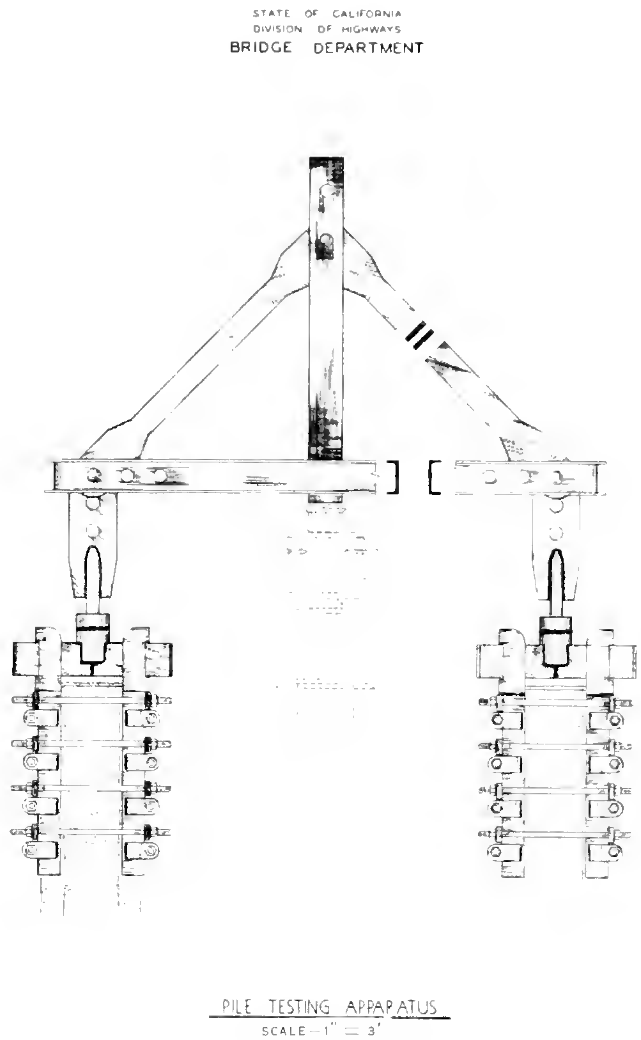


Fig. 1

Detail sketch of pile load test apparatus

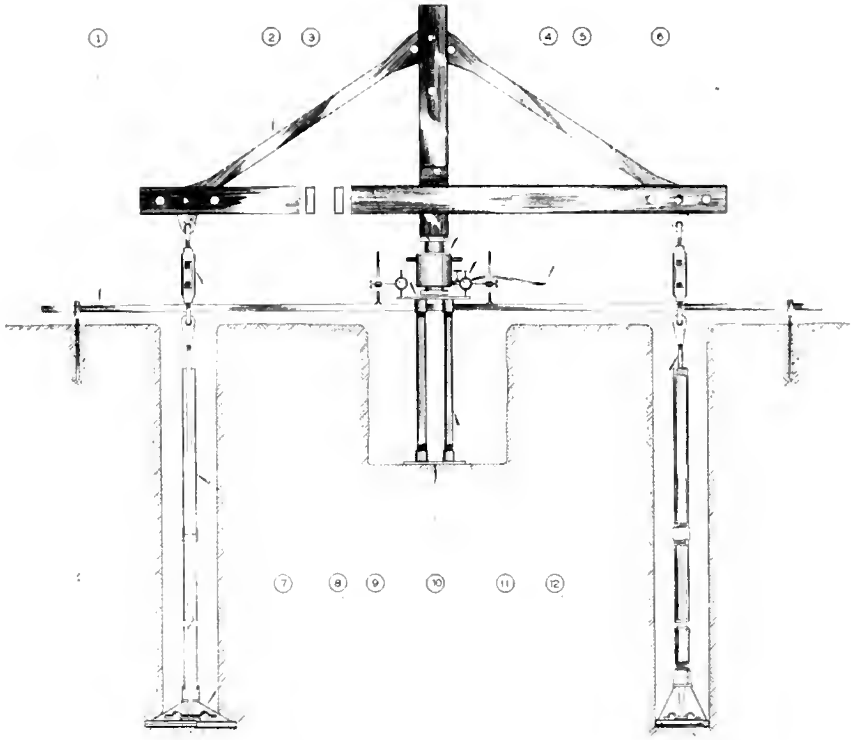
Field laboratory, tank and tool truck towing drill rig

Drilling Machine Efficiency

The drilling machine is capable of conducting rotary wet sample borings (wash borings), jet borings, bucket auger borings, undisturbed drive sampling operations, diamond or hard metal core borings, penetrometer tests, spud borings, or any other conceivable drilling operation in any kind of earth material to depths of about 400 feet.

A small, double-acting, pneumatic hammer is mounted on the rig and replaces the conventional drop hammer. This results in an increase in casing or penetrometer driving speed from 30 or 40 blows per minute to a maximum of about 500 blows per minute. The hammer is reversible which also facilitates and simplifies tool extraction.

The hammer is rigged in such a fashion that it may be used as a 140-pound drop hammer for conducting the standard penetration test or as a 350-pound drop hammer for making penetrometer tests. Air for the hammer is supplied by a 70-cubic-foot compressor. The pneumatic equipment, including tanks, compressor and engine, is mounted on a set of steel skids separate from those of the drilling machinery. This separate mounting was considered essential in order to insure the maximum in portability for the drill rig proper and at the same time maintain a low center of gravity for the entire unit.



LOAD TESTING APPARATUS

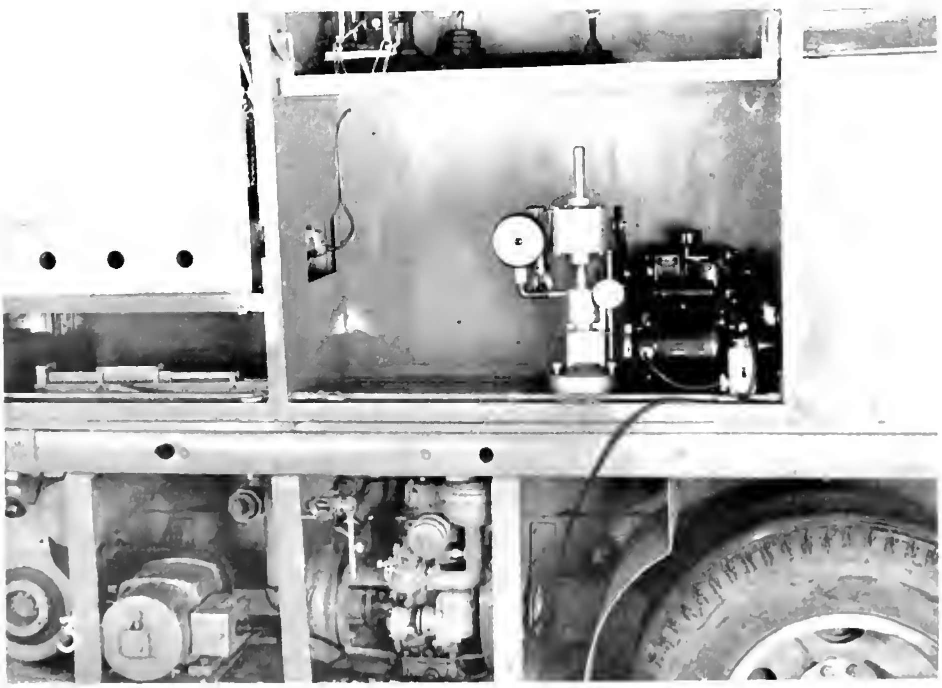
SCALE—1" = 3'

LEGEND	
1 GAGE SUPPORT, LOW THERMO EXP	8 2" OR 3" E.H. BLACK PIPE
2 REACTION FRAME	9 1 1/2" TURNBUCKLES
3 STEEL PLATE	10 BEARING PLATE
4 HYDRAULIC CELL	11 2" OR 3" E.H. BLACK PIPE
5 DIAL INDICATORS	12 1 1/2" STEEL ROD
6 HYDRAULIC PRESSURE LINE TO POWER UNIT	
7 ANCHORS, 4 WAY EXPANDABLE & RETRACTABLE	

Fig. 2

Detail sketch of plate bearing load test apparatus

Laboratory area on truck



Drill Motor Rotations

The drill head may be rotated 360 degrees in one plane or 270 degrees normal to the plane of full-circle rotation, thus permitting directional drilling in any direction. The drill motor is attached to the drill head and the motor mount is designed for full rotation to insure verticality of the motor regardless of drilling direction. A hand-crank feed was preferred to a power pull-down or hydraulic feed since it permits the driller to accumulate a feel-as-you-go experience so important to many drilling operations.

Three sets of quick-change gear ratios are available for the drill head to enable high-speed low-power tool rotation, or low-speed high-power operation. The drill head is powered by an 8-h.p. gasoline engine, and the

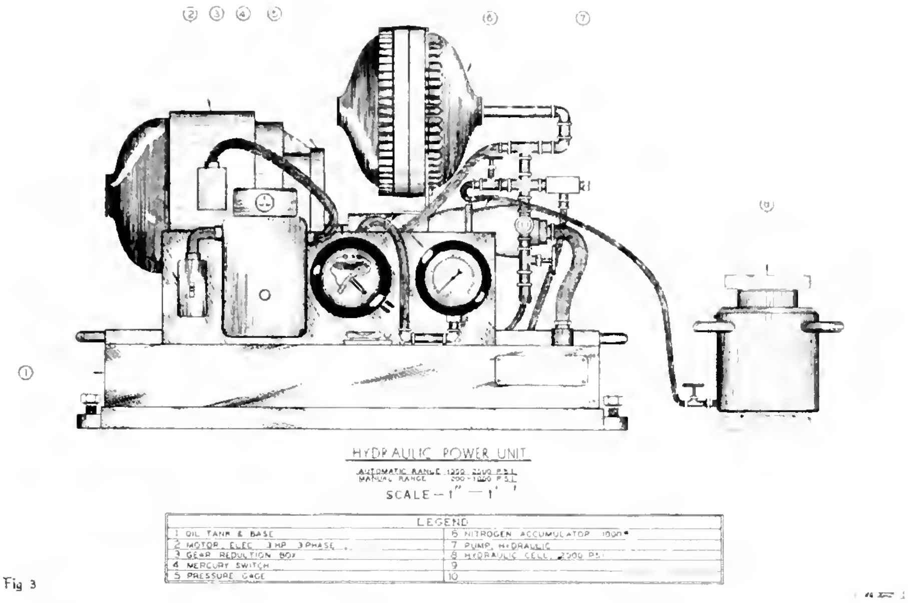
double drum hoist and water pump are powered by a similar 8-h.p. engine. Power to the drums is applied through a four-speed truck transmission mounted on the drill. The mast is of tubular design, hinged above the gear rack, and of sufficient height to handle 10-foot lengths of drill line, a two-foot bit and a one-foot water swivel with ample operating clearance between the swivel and the sheave.

Testing Apparatus

Men charged with the conduct and interpretation of bridge foundation studies must have available sufficient testing apparatus to permit on-the-job measurement of important physical characteristics of foundation materials. This is important if the drilling, sampling, and testing program is to match the complexity or simplicity of natural conditions, or if the field men are expected to acquire a valuable store of interpretative experience. Soil tests, such as unit weight, moisture content, resistance to penetration, permeability, and unconfined compressive strength, *(see Figure 4)* etc., lend themselves readily to field methods and equipment. Others, such as plate bearing tests for footing foundations, skin friction tests for determining required lengths for friction piles, and pile load tests, can adequately be conducted in no other place.

A truck *(see Photo 2)* designed to tow the drill rig, haul a 500-gallon water tank required for rotary drilling, carry casing, drill line, samplers, testing beams, hydraulic equipment, etc., also has a built-in compartment designed as a field testing laboratory. This area *(see Photo 3)* houses an unconfined compression apparatus, a small engine generator set, a constant temperature gas oven, a balance and other required testing equipment.

A constant pressure hydraulic power unit, powered by a lightweight, portable, 5-kw. engine generator set, is mounted in a one-ton panel truck. This vehicle is equipped with two full-width seats and is used for both personnel and equipment transportation.



Detail sketch of hydraulic power unit

Conventional method of conducting pile load test using water tanks (64T load)

Pile load test using "A" frame truss and jack applying a load of 115T (note anchor pile connection using bar steel)

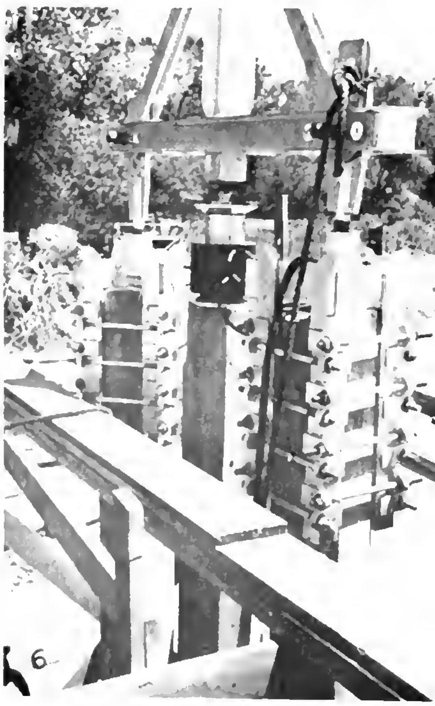
Pile Testing Apparatus

Both contractors and bridge engineers have long desired a method of test loading piles which does not require the use of large bulky water tanks (*see photo 4*) or equally bulky loading platforms. The apparatus shown in *Photo 5* may be used on a satisfactory basis in all cases in which adjacent anchor piles develop sufficient skin friction to furnish the desired reaction against the loaded pile. Since it is usually unnecessary to load test end-bearing piles the truss-anchor pile method can be use in practically all cases.

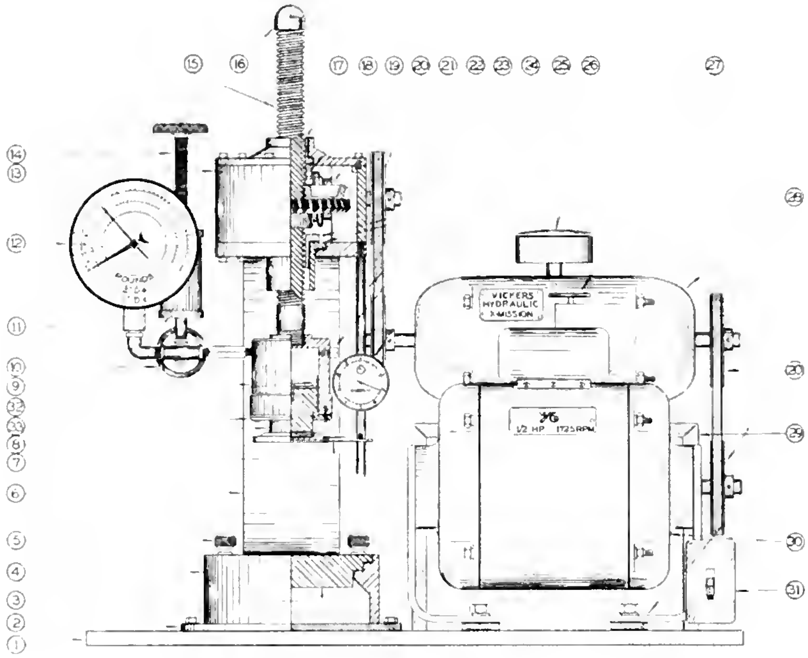
The truss is of steel construction and the members are pin-connected (*see Figure 1*). Pin holes are spaced at proper locations to permit sufficient horizontal adjustment to meet the normal requirements of variations in pile spacing. The truss is either tied to anchor piles by bending reinforcing steel over and around the pile clamp flanges (*see Photo 5*) or by means of friction type pile clamps as shown in *Photo 6 and Figure 1*. Both methods have been used with equal satisfactory results.

Load is applied to the test pile through a 115-ton pressure cell activated by a constant pressure hydraulic power unit (*see Photo 7 and Fig. 3*).

Load testing precast concrete piles at an awkward site 25 feet above ground level (note anchor pile clamps)



STATE OF CALIFORNIA
DIVISION OF HIGHWAYS
BRIDGE — DEPARTMENT



UNCONFINED COMPRESSION APPARATUS

SCALE – 1" = 0 5'

LEGEND			
1	MOUNTING PLATE	18	BALL THRUST BEARING
2	BASE PLATE	19	WORM GEAR ASSEMBLY 40-1 SINGLE PITCH
3	COMPRESSION PLATE, LOWER	20	PULLEYS - V-BELT 1-1
4	COMPRESSION PLATE SEAT	21	GUIDE BUSHING, LOWER SCREWSHAFT
5	LIFTING KNOB	22	SLEEVE
6	COLUMN	23	COMPACTION GAGE SHAFT
7	GAGE ARM	24	BLEEDER PLUG
8	PISTON, HYDRAULIC	25	COMPACTION GAGE
9	CYLINDER "	26	FILLER CAP
10	NEEDLE VALVE "	27	SPEED REGULATOR & REVERSE
11	LOADING CYLINDER	28	TRANSMISSION HYDRAULIC 1/2 HP
12	PRESSURE GAGE	29	MOTOR & TRANSMISSION MOUNTING
13	GEAR BOX	30	MOTOR ELEC 1/2 HP
14	LOADING PISTON SCREW	31	SWITCH
15	SCREW SHAFT 1"-8 ACME	32	NEO - PRENE CUP
16	CAP	33	PISTON RETAINING RING
17	GUIDE BUSHING, UPPER SCREWSHAFT	34	

Fig. 4

Detail sketch of unconfined compression

Automatic Power Unit

The power unit is automatic in operation and incorporates a constant pressure mercury switch and a 1,000 PSI nitrogen loaded accumulator. The gas accumulator cell insures the maintenance of constant pressure of the desired increment even though the loaded pile settles. This feature eliminates the necessity of constant gage observation and frequent manual applications of load. The constant observation requirement has, in the past, been the principal objection to the use of hydraulic tools for work of this nature.

The method, in addition to utilizing light and easy-to-assemble apparatus, permits the application of load increments of any desired amount and at any desired time interval. Loads may be applied, reduced, or completely removed merely by turning a valve and thus a great deal of additional information may be acquired concerning the reaction of the pile to load than has been possible in the past due to the labor expense involved in loading or unloading piles by conventional methods.

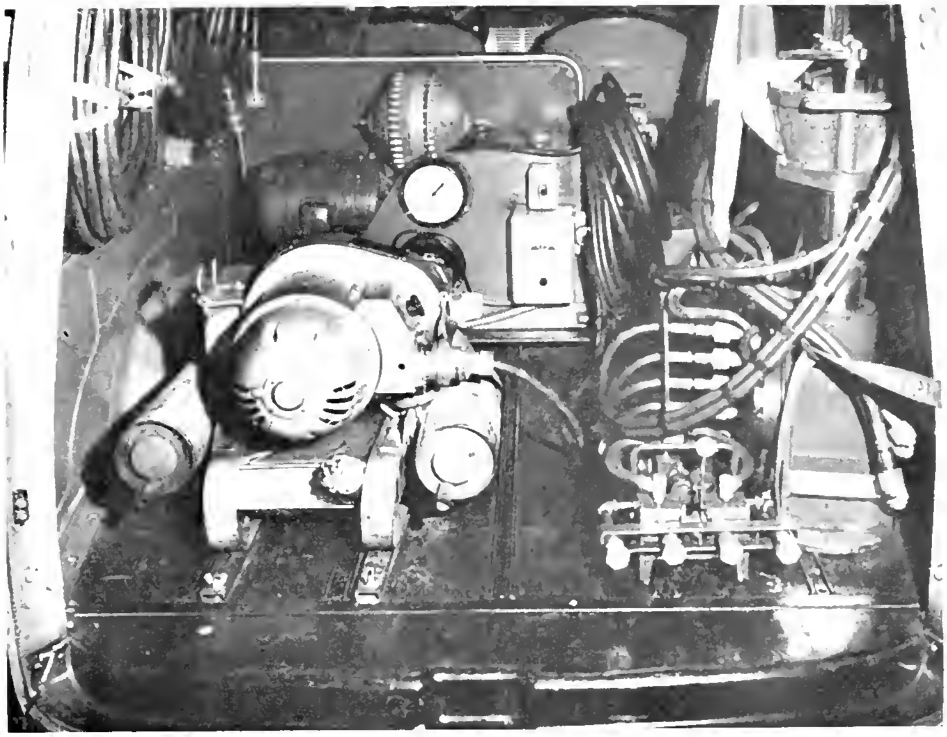
Lood Tests for Footing Foundotions

An "A" frame truss, similar to that used in the conduct of pile load tests, is utilized for loading bearing plates to determine safe allowable loads for footing foundations.

The truss in this case is of lighter construction than that used for pile load tests, and the horizontal beam is considerably longer in order to insure that anchor points are far enough away to be outside the influence area of the loaded plate (*see Figure 2*). Reaction against load is obtained by means of 12-inch expanding anchors placed in holes drilled at the ends of the horizontal beam. The anchors are collapsible upon completion of the test and may be recovered for future use. Load is applied in the same manner as stated above for pile load tests (*see Photo 8*).

Skin Friction Tests for Determining Pile Lengths ond Bearing Copocities for Friction Piles

Five-foot lengths of 2½-inch O.D. flush joint, thick wall steel tubing, are driven into the soil in strings of desired length and permitted to remain in place for periods of time varying from a few hours to several days as dictated by the consistency of the sediment. Double-acting power-operated hydraulic jacks with suitable gages (*see Photo 9*) extract the tool and measure the frictional resistance offered to pulling. Data obtained in this manner are then used in conjunction with standard penetration, and unconfined compression data to furnish a basis for estimating the safe allowable load and required pile lengths for friction-type piles.

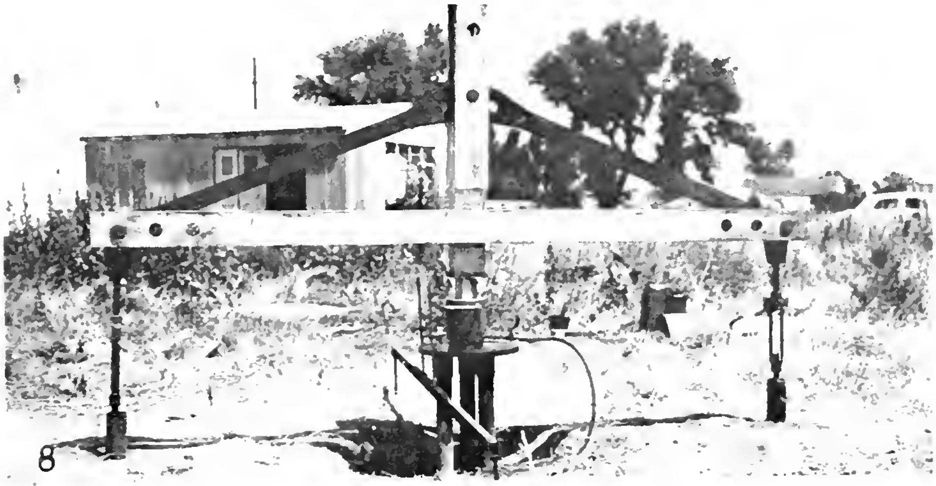


Hydroulic power unit, five-kilowot engine generotor ond stroddle jacks mounted in ponel truck

Personnel

A new state civil service classification was established in order that suitable personnel might be obtained for work of this nature. Men were needed who, by academic training, interest, and experience, were prepared to do professional grade work in the three fields of geology, soil mechanics and civil engineering. The civil service title adopted for men doing work of this nature was that of engineering geologist. The examinations were so thoroughly packed with questions in all three fields that only those men who met the prescribed prerequisites were capable of competing for employment on a satisfactory basis.

Conducting o lood test for o footing foundotion, using o five-squore-foot oreo beoring plote



Two Study Units

The Bridge Department now has two complete foundation study units, one of which works out of the Sacramento office and the other out of the Los Angeles office. Each unit requires the services of three men consisting of an engineering geologist, a foundation drilling foreman, and a driller.

There has been no change from the department's former policy of making preliminary foundation investigations for bridges by the use of preliminary survey crews and the soil tube method. In many cases review of such data clearly indicates that further study is not desirable or necessary, and by the same token preliminary studies of this nature furnish the Foundation Section with sufficient data to make it clear when further studies are needed to in-

sure the maximum in design and construction economy. In all such cases additional data are now readily obtainable.

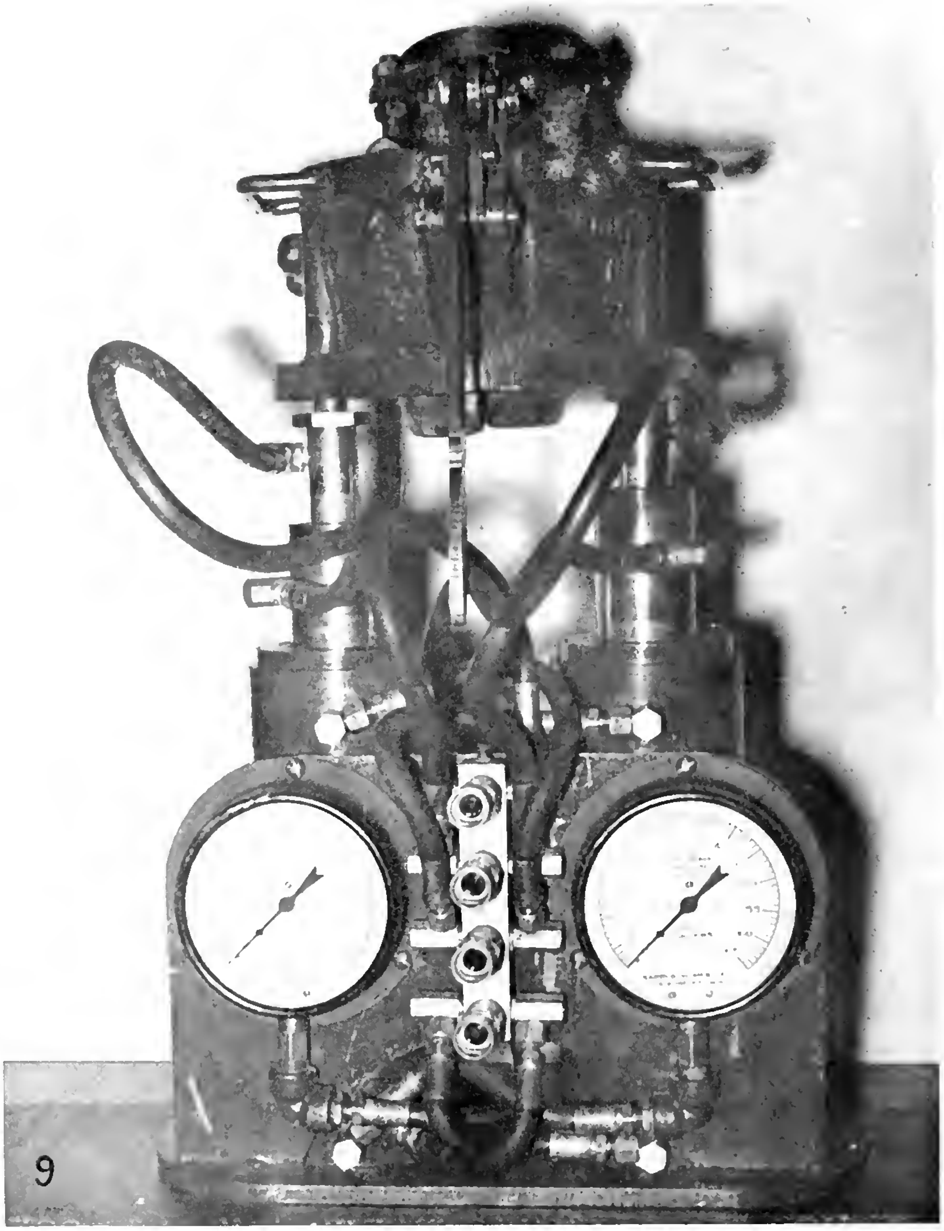
All field testing apparatus of a laboratory nature was designed for the dual purposes of measuring significant mechanical properties of earth materials and assisting field personnel in the accumulation of a store of valuable experience which will ultimately result in reduced testing requirements. It is not feasible to conduct important laboratory tests such as consolidation studies, triaxial shear or compression strength determinations of weak, cohesive, or cohesionless, sediment, etc., in the field since permanent laboratory facilities are required for such work. A recent study of complex foundation conditions for a section of the Bayshore Freeway near South San Francisco between Sierra Point and Candlestick Point was conducted as a joint study by the Materials and Research Department and the Bridge Department. The Bridge Department made the borings and took the samples (*see Photo 10*), and the Laboratory made the required soil mechanics tests and interpretation of sediment character. The data thus obtained were then presented in a joint report for design consideration.

We can be proud of our existing facilities for conducting modern foundation studies since they are second to none, and as we or others improve old or develop new and better methods they will be adopted.

Acknowledgments

Space does not permit the listing of all who contributed time, ideas, cooperative spirit, and encouragement in developing these new tools and methods, but special recognition is due:

1. The California Division of Highways Headquarters and District VII shops;
2. The Garrison Hydraulic Manufacturing Company of Los Angeles;
3. The Frank L. Howard Drill Engineering Company of Los Angeles;
4. The Division of Highways Materials and Research Department.



9

Double-acting hydraulic straddle jacks

Making power borings from 14 x 28-foot pontoon barge in San Francisco Bay

10

Piru Gorge

Continued from page 31 . . .

The variable winds through the Gorge create a dust problem, especially after blasting. The dust clouds sometimes take off in an unanticipated direction and travel farther than expected, sometimes to the discomfort of waiting motorists.

Fortunately Piru Creek, which closely follows the road for almost its entire length, furnishes ample water.

Basins have been dug at several points along the grade and lined with drilling mud to prevent seepage. Water is hauled to these basins by tank trucks and pumped through temporary pipe lines to soak all material possible to reach, before being loaded into trucks.

The application of the water before the material is delivered to the fill has not only been a great help in the alleviation of the dust nuisance but, in conjunction with supplementing the sheepsfoot tampers with 25-ton pneumatic tampers, has resulted in very satisfactory compaction of fills.

While the contractor's operations are retarded by the frequent shutdowns of his equipment to allow for the passage of traffic, advantage has been taken of favorable weather conditions and weekly reports show a continual gain on the time cycle.

. . . Continued on page 62

This is a real job for bulldozers in Piru Gorge

Contractors on the job in Piru Gorge call this "The Big Fill"

Cordelia Project

Another Freeway on U. S. 40 in Solano County Is Under Way

By E. L. CRAUN, Resident Engineer

Director of Public Works C. H. Purcell on November 21st authorized the Division of Highways to advertise for bids for construction of the final unit of four-lane divided highway on U. S. 40 between the western end of the Yolo Causeway and the Carquinez Bridge. The project will be 1.7 miles in length between Alamo Creek and Ulatis Creek, for which the California Highway Commission has budgeted $980,000. Construction of the West Sacramento Freeway from the Tower Bridge across the Sacramento River to the eastern end of the Yolo Causeway, is under way.

In July of this year, construction started on another section of limited freeway on U. S. 40 in Solano County between the Cordelia Underpass and Ledgewood Creek.

This section of highway carries all the traffic from the Bay area to the east and north of Sacramento. There is also an appreciable amount of traffic bound for Stockton and way points in the delta region.

The present construction will convert the existing 20-foot, two-lane pavement into a four-lane divided highway having two 12-foot traffic lanes on each highway, with five-foot shoulders on the inside and eight-foot shoulders on the outside of the pavement.

The underpass under the Southern Pacific railroad will be widened to accommodate an additional three 12-foot traffic lanes.

A shoofly around the underpass during its construction is necessary to care for the railroad traffic.

Railroad Cooperates

Under an agreement signed by the State and the Southern Pacific Company, a shoofly 1,426 feet long, consisting of 1,172 feet of fill and 254 feet of trestle over the highways has been constructed by the contractor under bid items. The railroad company is placing the ties, rails, and ballast with its own forces.

The Founding Fathers Had Their Traffic Troubles!

A lot of folks wail about the traffic jams they get tangled up in every now and then. "Traffic," they contend, "is getting to be the country's No. 1 problem."

Well, we'll just have to grin and bear it; for the traffic problem, like free speech and a lot of other things, seems to be a good old American heritage. Way back in 1757, 16 years before the Boston Tea Party, the Founding Fathers were having their traffic troubles—and on the Lord's Day, too!

Several years ago, the Boston *Transcript* dug down into the city's musty files and came up with a quaint old ordinance to that effect, executed by the selectmen of Boston 193 years ago.

"Owing to great danger," declared the City Fathers, *"arising oftentimes from Coaches, Slays, Chairs, and other Carriages, on the Lord's Days, as people are going to or coming from the several Churches in this Town, being driven with great Rapidity, and the Public Worship being oftentimes much disturbed by such Carriages, it is therefore Voted and Ordered, that no Coach, Slay, Chair, Chaise or other Carriage, shall at such times be driven at a Greater Rate than a foot Pace, on Penalty to the Master of the Slave or Servant so driving, of the Sum of ten shillings."* —A. F. S.

A short distance northeast of the underpass, a new structure will carry eastbound traffic coming through the Jameson Canyon from the Napa Valley over both highways of U. S. 40.

New bridges on the added highway are being constructed at Green Valley, Dan Wilson, and Suisun Creeks.

Bridges on the present highway at Green Valley and Suisun Creeks are to be widened. The bridge crossing Dan Wilson Creek is to be rebuilt because of structural weakness.

Eight-foot by eight-foot cattle passes are being constructed under U. S. 40 a short distance south of the underpass and under the Jameson Canyon Road a short distance west of the overpass. These structures are for the use of a property owner having large holdings on each side of the two highways.

The project starts in the southbound highway at the end of the American Canyon pavement placed last year and goes through the new portion of the underpass to a connection with the existing highway approximately 1,450 feet northeast of the underpass.

Joins Fairfield By-pass

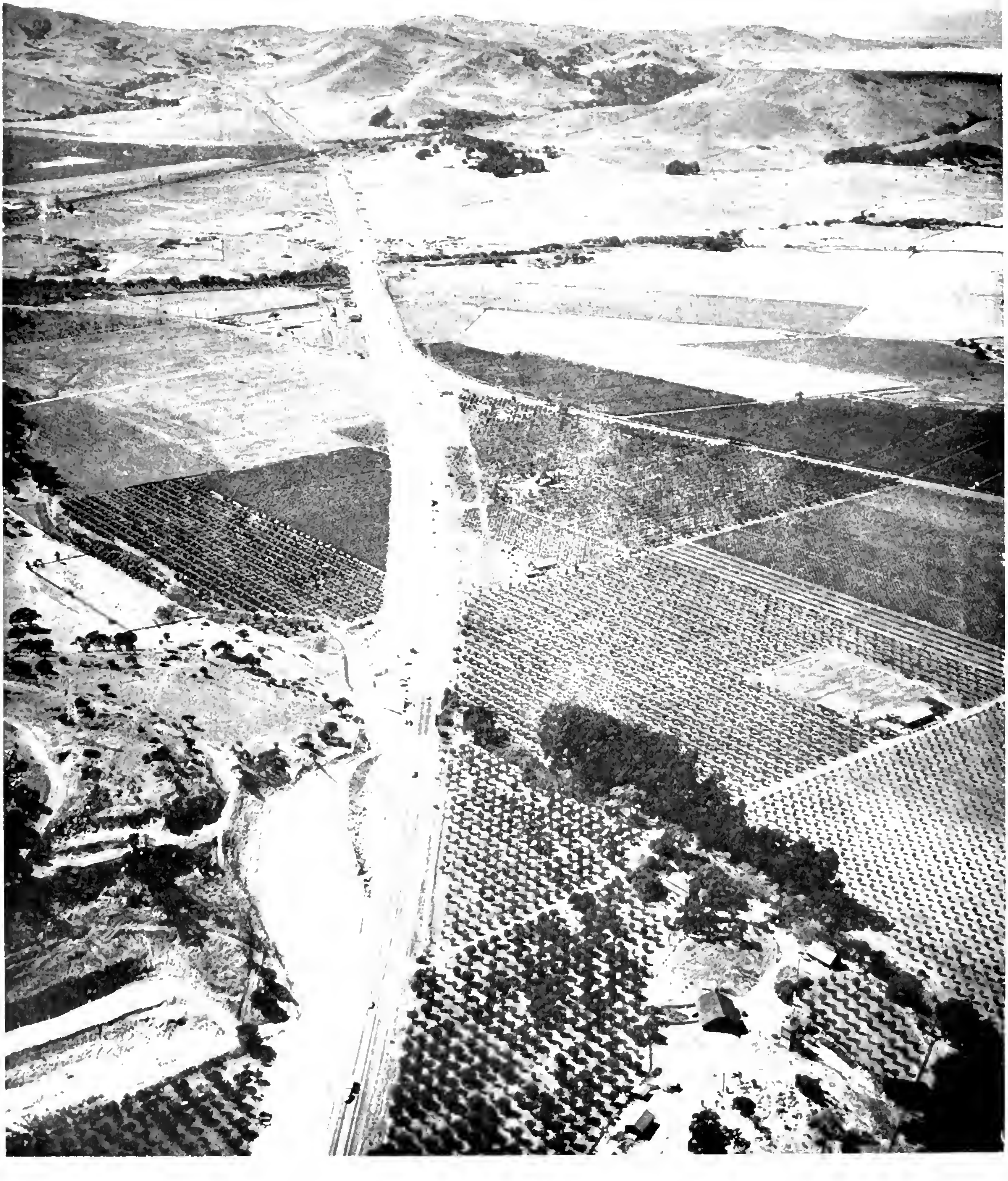
The new construction starts in the northbound highway at the underpass and carries on parallel and 62 feet easterly from the existing highway to a connection with the Fairfield By-pass pavement near Ledgewood Creek.

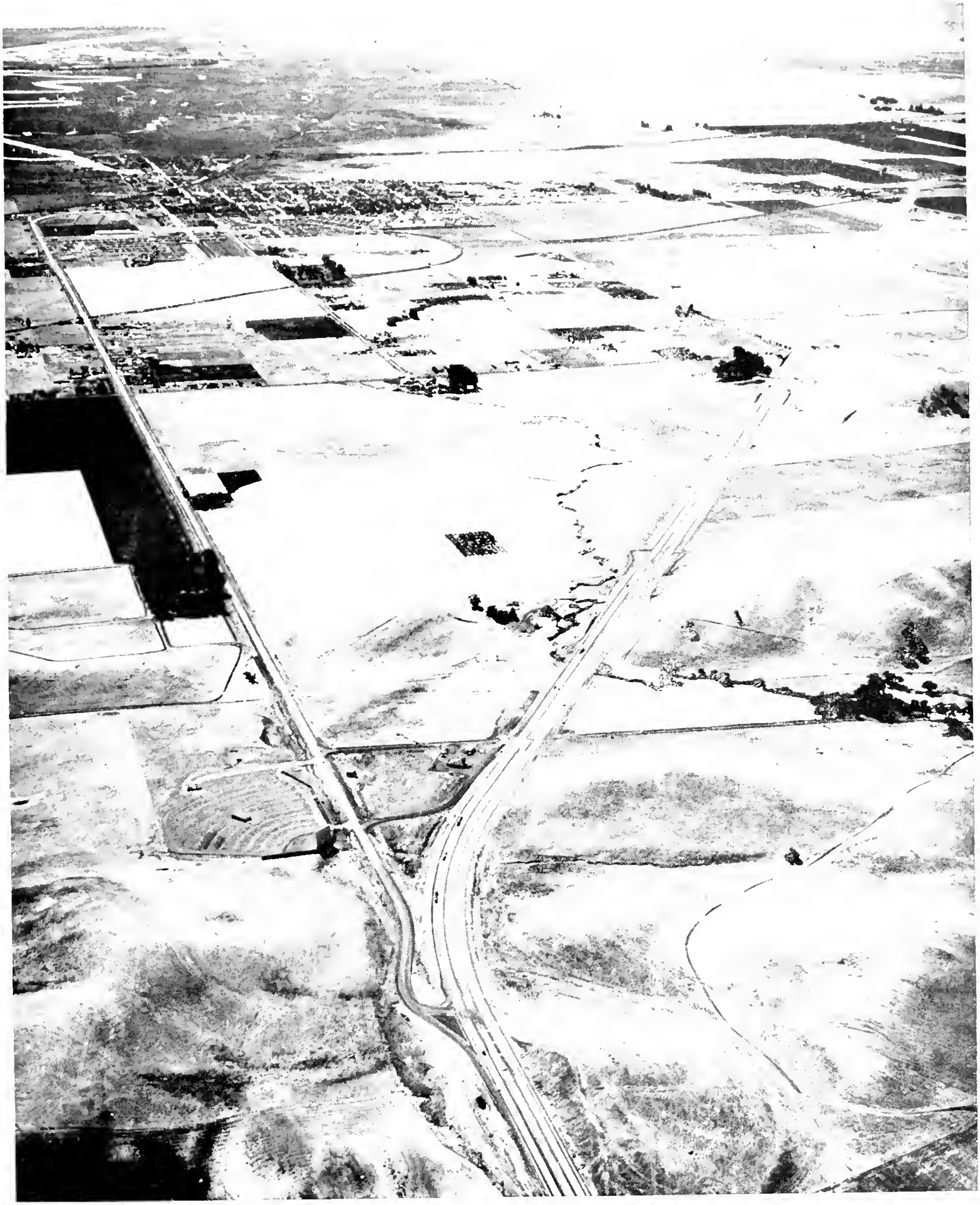
The new construction consists of 8 inches by 24 feet of Class 'B" concrete pavement on 10 inches of imported base material, the top 4 inches of which is to be stabilized with Portland cement. Six inches of select material is to be placed under the imported base on U. S. 40.

The shoulders are to be constructed of untreated rock base from 6 inches to 4 inches thick, and topped with 2 inches of dense graded plant-mixed surfacing 8 feet wide on the outside and 2 feet wide on the inside of the pavement.

On the southerly 1.22 miles of the existing pavement, border trenches 6 inches deep and 3 feet wide are to be

On the opposite page is an aerial view looking toward Fairfield with the Cordelia Underpass now under construction in the immediate foreground. On page 46 is an aerial photograph showing construction between Fairfield and the Napa Wye. On page 47 is an aerial view graphically showing the recently completed Fairfield Bypass looking toward Fairfield. The old route through Fairfield is shown on the left. The relocated highway is on the right





excavated on each side of pavement and filled with cement treated rock base.

Pavement Construction

The shoulders on the remainder of the old pavement were previously cement treated by maintenance forces.

The southerly 1.09 miles of this stretch is to be blanketed with 24 feet by 2 inches of open graded plant-mixed surfacing. Borders 2 feet wide on the inside and 1 foot wide on the outside are to be constructed of like material. The remainder of the 8-foot shoulder on the outside is to be covered with 2 inches of dense graded plant-mixed surfacing.

The remainder of the old pavement and shoulders are to be covered with a 6-inch blanket of untreated rock base, after which the central 24 feet are to be paved with 3 inches of dense graded plant-mixed surfacing. A 2-foot by 2-inch border is to be placed on the inside shoulder and the outside shoulder is to be paved full width.

Grading Not Heavy

Compared to other completed jobs in this vicinitiy, grading is not heavy.

The material is being loosened with a rooter and moved with scrapers.

The largest cut is near the center of the job and is composed of a fair grade of tuff that varies in quality to such an extent that it could not be used for imported base material, but was of considerably better quality than the soil encountered elsewhere.

Approximately 34,000 cubic yards of deficiency fill is being obtained from this cut and is being used as select material under the imported base material. Extensive preliminary investigations were made in this cut which proved the tuff was not satisfactory for subgrade material. Inasmuch as this cut was a logical and attractive source from a bidder's standpoint, prohibition of its use was included in the special provisions.

The imported base material is being obtained from another deposit of tuff approximately three miles north of the job.

Soft Rock Deposit

Specifications require that the maximum size for the lower 4 inches be 2½ inches, and for the upper 6 inches, the maximum will be 1½ inches. It is also required that the material be reduced to these sizes before being delivered to the job.

The deposit is a soft rock that builds up on crusher surfaces and for this reason the ordinary type of crushing equipment will not work efficiently in reducing the material to size.

The contractor has elected to do the necessary crushing in the pit with a rooter, a disk, and the tracks of the tractors.

Items of Work

Following are approximate quantities of the major items of work:

Roadway excavation	191,000 cu. yds.
Structure excavation	10,500 cu. yds.
Structure backfill (bridges)	2,420 cu. yds.
Overhaul	4,315,000 sta. yds.
Imported base material	59,000 tons
Mixing and compacting cement treated subgrade	80,000 sq. yds.
Plant-mixed surfacing	25,000 tons
Class "B" Portland cement concrete (pavement)	18,000 cu. yds.
Class "A" Portland cement concrete (structures)	3,800 cu. yds.
Structural steel	462,600 lbs.
Furnishing concrete piling	8,360 lin. ft.
Driving concrete piling	224 each
Chain link fence	1,800 lin. ft.
Culvert pipe	3,400 lin. ft.
Bar reinforcing steel	396,000 lbs.

To date the grading is 90 percent done, the three bridges on the new highway are poured, and the shoofly tracks are finished. The work of placing imported base has just started. Most of the culvert pipes crossing the highways are in, and work has started on the construction of the two cattle passes.

It is expected that the work will be complete by July of next year.

The contractor for the project is Parish Bros. of Benicia.

The writer is the resident engineer working under the general supervision of M. C. Fosgate, District Construction Engineer. Mr. Gayner is the Bridge Department's representative in charge of structures.

CODE OF ETHICS OF EMPLOYEES OF RIGHT OF WAY DEPARTMENT OF DIVISION OF HIGHWAYS OF STATE OF CALIFORNIA

Recognizing our responsibility to our department and to the people of the State of California and feeling that we should encourage and foster high ethical standards in our organization, we do hereby subscribe to the following code of ethics for our constant guidance and inspiration, predicated upon the basic principles of trust, justice and fair play.

1. To show faith in the worthiness of our profession by industry, honesty and courtesy, in order to merit a reputation for high quality of service and fair dealing.
2. To add to the knowledge of our profession by constant study and to share the lessons of our experience with our fellow employees.
3. To build an ever increasing confidence and good will with the public, our employers, by poise, self-restraint and constructive cooperation.
4. To ascertain and weigh all of the facts relative to real properties in making an appraisal thereof using the best and the most approved methods of determining just compensation.
5. To conduct ourselves in the most ethical and competent manner in our negotiations with affected property owners, thus meriting confidence in our knowledge and integrity.
6. To accept our full share of responsibility in constructive public service to community, State and Nation.
7. To strive to attain and to express a sincerity of character that shall enrich our human contacts, ever aiming toward that ideal—the practice of the "Golden Rule."

In Memoriam

GEORGE A. TILTON, JR.

With the passing of George A. Tilton, Jr., on July 31, 1950, the California Division of Highways lost one of its most experienced and valued employees and his associates a loyal and esteemed friend.

Tilton was born at Delano, California, on December 20, 1890. He entered the service of the Division of Highways in 1918 as Chief of Party on surveys in the San Luis Obispo District, rising to Assistant District Engineer in 1931. In 1933 he transferred to Sacramento as Assistant Construction Engineer in the Headquarters Construction Department and served in that capacity until his death.

While employed in District V under the supervision of then District Engineer Gibson, Tilton had a great deal to do with the location and construction of the state highway along the Monterey Coast between San Simeon and Carmel, as well as several other large projects.

Always interested in the more important features of highway construction, Tilton became an authority on highway drainage, being co-author of the handbook entitled "California Culvert Practice," which has been in great demand by road building agencies throughout the world since its publication in 1944.

Over the years Tilton has been intimately connected with prison labor work, first in District V along the Monterey Coast and later as Headquarters' representative on all such work in the various districts throughout the State. He eventually became a national authority on the administration of prison labor camps and a series of articles on this subject recently appeared in *California Highways and Public Works*. It is proposed to publish these articles in booklet form.

In 1925-26, during an intermission in state service, Tilton was employed as an engineer by William Randolph Hearst in the laying out and construction of the road from San Simeon to Hearst's "castle" on one of the hills several miles away. According to Tilton one of the interesting conditions of this assignment was that either the castle or the ocean must be in view from every point on the road; also, that no trees would be allowed to be destroyed.

Several years ago he became interested in boating on the Sacramento River and acquired a cabin cruiser on which he spent many happy days with his family and friends on the river and in the delta region. During World War II he was appointed commander of the local flotilla of the U. S. Coast Guard Auxiliary. In recent years he was very active in the Sacramento Yacht Club and was instrumental in the development of Miller Park.

Tilton was an ardent philatelist and possessed one of the finer Sacramento collections. Another of his pet avocations was hunting, and every year Tilton roamed the fields and mountains in search of pheasants, waterfowl and deer. He was considered a crack shot with the rifle.

In 1919 Tilton joined the American Society of Civil Engineers and, at the time of his death, was an Associate Member, Sacramento Section.

George Tilton's passing has left a void not only in the ranks of those who are following his profession but also among those in the many other walks of life with whom he was so closely associated.

Rodney C. Richardson Succeeds W. H. Hamblin

DIRECTOR of Public Works C. H. Purcell has announced the appointment of Rodney C. Richardson of Sacramento to succeed W. H. Hamblin as Assistant to the Director. Hamblin has been called back into service with the Navy as a commissioned officer. Richardson will serve until Hamblin returns.

WILLIAM H. HAMBLIN

After attending the University of California at Los Angeles and the University of Southern California, Richardson served in the Marine Corps during World War II. He first entered state service as executive secretary of the Governor's Veterans Committee, which later became the California Veterans Commission, in November of 1944. He served successively as assistant chief, Airport Master Planning Staff; coordinator of centennial affairs and then as Deputy Director, Governor's Office of Planning and Research. He left state service in 1948 and has been engaged in general insurance business in Sacramento during the last two years.

Traffic Interchange Design

By SAM HELWER, Assistant Engineer of Design

A TRAFFIC INTERCHANGE is defined as: "A system of interconnecting roadways in conjunction with a grade separation or grade separations providing for the interchange of traffic between two or more roadways or highways on different levels." A traffic interchange permits safe and uninterrupted flow of the through traffic and minimizes the hazards and interruptions to the turning movements by elimination or reduction of the conflicts inherent to an intersection at grade.

It must be understood that complete elimination of conflict and uninterrupted direct flow of all of the turning movements is not achieved. While the interchange minimizes these conflicts, there is always a residual minor conflict at the ramp entrances and exits due to weaving at these points. Some interchange types require left turns at grade on the roadway of secondary importance, while others require unnatural and circuitous movements which introduce an element of confusion. Complete elimination of these features is usually not economically justifiable. However, in spite of this trading of points of conflict, the reduction in number and degree of hazards makes the traffic interchange the safest and most efficient method of providing traffic service at the intersection of two or more roadways.

INTERSECTION CONFLICTS

The area within an intersection at grade is at once an integral part of each road, resulting in conflicts which can be divided into three general types: head-on, cross and turning. Although the head-on conflict between movements in opposite directions on the same roadway pertains to the entire facility and not just the intersection, this conflict does add to the intersection problem. It can be eliminated by construction of a divided roadway.

WARRANT FOR DIVIDED HIGHWAY

The most important factor in determining the warrant for construction or improvement of a facility to four lanes divided is traffic capacity. An accepted figure of 5,000 A.D.T. has been used in California. This figure must be carefully analyzed, however, because the average daily volume does not give a complete picture of traffic capacity. Peak hour volumes, cross and turning movements, grade rates, sight distance and percentage of trucks all have a direct bearing on the capacity of any facility. There are circumstances where construction of a four-lane divided highway is warranted where the A.D.T. volume is less than 5,000. In other circumstances a volume in excess of 5,000 may not be sufficient warrant, in itself, to construct a divided highway section.

CROSS CONFLICT

The cross conflict between the four straight through movements can be eliminated by providing a grade separation structure, with the necessary raising or lowering of the grade line of one or both of the crossroads. Having accomplished this, however, the solution of the intersection problem has only started.

TURNING CONFLICT

In addition to the four through movements, there are four right turn and four left turn movements, making a total of 12 movements, which must be segregated to provide the interchange facilities between the two through roads. It is relatively simple from a design standpoint to provide free-flowing connections for the four right-turn movements. These connections can depart naturally from the right side of one facility to join in a merging movement on the right side of the cross facility. The four left-turn movements, however, are a different problem. If the left turns could be eliminated, one basic interchange pattern could serve all intersections. It is the left turns that are responsible for the various types and shapes of interchanges.

WARRANTS FOR GRADE SEPARATION

The elimination of the inrersection at grade has always been more of a problem in economics than a problem in engineering. It is quite evident that a system of priority must be established in order that the most important intersections will be taken care of first.

The only recognized numerical warrant is the American Association of State Highway Officials' warrant for grade separations on the Interstate Highway System, which states, "For a design traffic densiry of 3,000 vehicles *per hour* or more on an interstate highway or equal, every effort shall be made to eliminate all cross traffic at grade." This warrant is satisfactory as far as it goes, but there are many situations not covered in this statement where grade separations are warranted.

The usual engineering approach to a problem is to reduce all variables to a numerical quantity or to set up a formula which can be solved for a negative or positive answer. For this problem, however, no satisfactory mathematical solution has yet been devised.

1. Topography Warrant

There are, however, several general warrants for grade separations which must be given consideration. Of these, the most obvious is where topography is such that other types of intersection design cannot be utilized. This warrant is not frequently encountered due to the ability to change topography cheaply with modern earth-moving equipment.

2. Bottleneck Warrant

Another warrant is the elimination of a bottleneck where existing intersection facilities are no longer adequate to carry peak hour flow. Although a separation structure will eliminate this

type of bottleneck, there are locations where a cheaper solution can be used effectively, if cooperation of the local governing bodies can be obtained. Many cities have already demonstrated that one-way streets and elimination of parking and left turns are inexpensive methods of relieving existing traffic problems. Due to the high costs involved in interchange construction and the large number of existing congested intersections, it will be many years before relief can be obtained by this method. It will be necessary in many instances to obtain the support of local governing bodies to set up a more effective local street traffic pattern.

The recently completed Roseville railroad underpass illustrates another example of this warrant. Traffic counts made prior to construction indicated 11,000 vehicles and 3,500 pedestrians used the crossing daily. Since this grade crossing was situated at the throat of one of the busiest railroad classification yards in the country, there were an unusually large number of train movements. Checks showed the crossing was blocked 20 percent of the time, including an average of 15 trains a day which stopped traffic for five minutes or more.

3. Isolated Intersection Warrant

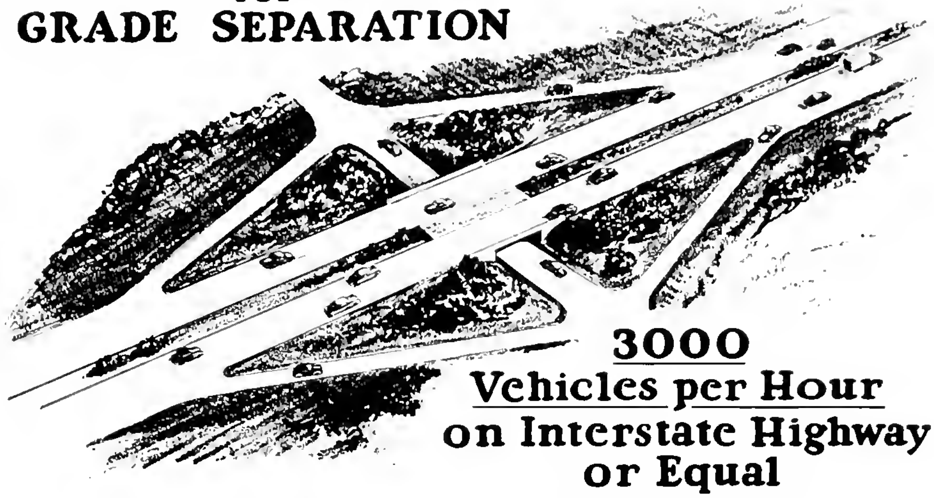
Still another warrant is the prevention of accident at an isolated intersection where high speed and the element of surprise result in a site of recurring accidents.

4. Freeway Development Warrant

A freeway or expressway development, for the safe and rapid movement of heavy traffic volumes, furnishes the most important warrant for a grade separation. A freeway, by definition, requires the complete elimination of all intersections at grade. Similarly, an expressway, by definition, generally requires grade separations at intersections. On this type of highway development, the actual numerical warrants of a particular grade separation must be submerged in the design of the artery as a whole.

There is a further ramification of this particular warrant. A community being served by a conventional type of highway, with its attracted commercial strip developments and heavy volumes

A.A.S.H.O. WARRANT for GRADE SEPARATION



3000 Vehicles per Hour on Interstate Highway or Equal

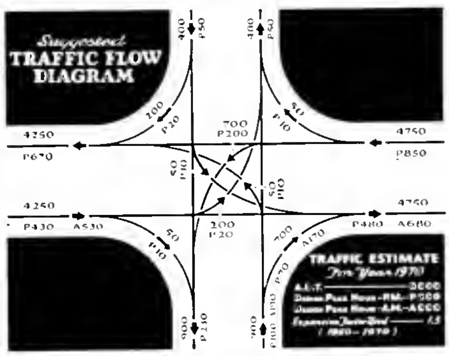
of through traffic, is effectively severed by the attendant hazard, confusion and congestion. Replacement by freeway construction with free-flowing interchanges and safe crossings of the traffic streams on grade separations, has the effect of binding the community together again. Therefore, for this type of development, strict numerical warrants must be tempered with community service, land use and local street circulation considerations; obviously no empirical formula would be satisfactory.

DETERMINATION OF INTERCHANGE TYPE

After selection of the interchange locations, the next step is the selection of the type of interchange. A determination of type must be based on several influencing factors, including a complete traffic analysis, available funds, topography, building developments and right of way limitations. These factors and subsequent development of interchange requirements are frequently so extensive that their fulfillment reflects on the location of the entire freeway. The location of a freeway should not be fixed to a definitely located center line until the traffic interchange problems have been carefully analyzed and evaluated along with other factors influencing location.

1. Traffic Analysis

The design of a traffic interchange should not be undertaken until a complete traffic analysis covering both present and future needs has been made. This analysis should include A.D.T., peak hour volumes and time of peak hour flow for all 12 of the movements through the intersection. In California, the design of an interchange is based on the traffic movements anticipated 20 years after construction. The traffic flow diagram gives an indication of the most desirable interchange type from a traffic service and safety standpoint.



2. Other Factors

If economy could be overlooked, it would be unnecessary to list any other factors influencing design except traffic. Since this is not the case, it is necessary to give a complete study to topography, building development and right of way limitations which control the type of design and construction to the funds available for the project.

3. Single Line Design Sketches

An experienced designer, with full knowledge of the traffic, topography and developments at a given location, can recognize a suitable design for that

location, provided it is one of the simpler design types. However, for major interchanges and complicated conditions of traffic and physical controls, it is necessary to study and develop a series of designs which must be carefully analyzed before a determination can be made of the most suitable design.

At this stage of design, the preferred method of study is a development of freehand scale sketches, showing each one-way pavement as a single line. This method is time saving to the designer who is not yet concerned with details and dimensions. An excellent discussion of this method of preliminary design is contained in the Bureau of Public Roads pamphlet by Loutzenheiser and Leisch on the Preliminary Design of the Kenilworth Interchange near Washington, D. C.

For the purpose of headquarters review and approval of a general plan for a complicated interchange, it is recommended that several single line sketches of possible alternate plans be submitted at early plan stage. The single-line drawings should be on a relatively small scale, say 1 inch=200 feet, and should also include proposed profiles on an appropriate scale.

INTERCHANGE CLASSIFICATION

Interchanges can be classified into two general types—direct and indirect. In the direct type of interchange, left movements turn more or less naturally toward the left, while right movements turn directly right. This is in contrast to the indirect type of interchange where both left and right movements first turn right. The left turn then goes through a 270 degree loop or turns across traffic at grade on the cross facility before going over or under the stream of traffic on the road in the original direction of travel.

1. Direct Type

Direct type interchanges are usually designed for heavy turning volumes where an indirect loop arrangement would be inadequate and the circuity of travel would develop a substantial economic loss in operating costs. This type may be used at the intersection of two major highways and frequently requires multiple structures or multiple vertical-level single structures. The direct type provides a maximum of traffic service, but may be expensive to construct.

At the intersection of two major traffic arteries, it is sometimes necessary to eliminate interchange connections for the minor movements in order to provide free-flowing direct connections for the major movements. The minor movements that are sacrificed for the major movements can usually be provided for at other locations removed from the major interchange site. From an operation standpoint, the simplest traffic interchange is the most desirable interchange. This is particularly true where heavy volumes of interchange traffic must be accommodated.

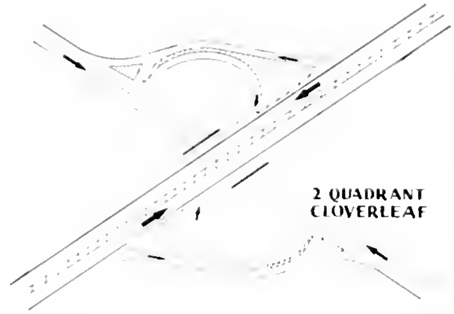
The definition of a traffic interchange includes the interchange of traffic "between two *or more* roadways or highways." Unfortunately this is a true statement; interchanges are required occasionally at the intersection of more than two roadways. When this happens it is extremely difficult to achieve a design that can be called either simple or direct. The answer to this problem does not lie wholly in the field of interchange design. Its solution is in proper location of line in the advance planning stage. When the location of a freeway results in an intersection of more than two roadways, every effort should be made to relocate either the freeway or one or both of the intersecting roadways.

2. Indirect Type

The indirect interchange includes the cloverleaf design with its various modifications, the diamond type, the bridged rotary, the trumpet type and hybrid combinations of all of these.

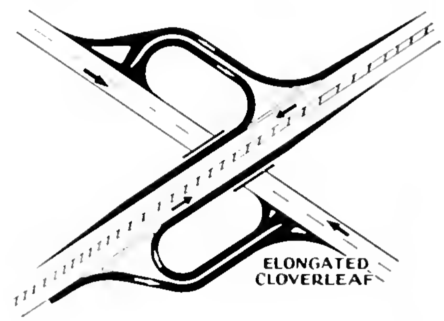
TWO-QUADRANT CLOVERLEAF

There are other types of cloverleaf design that have been used more fre-

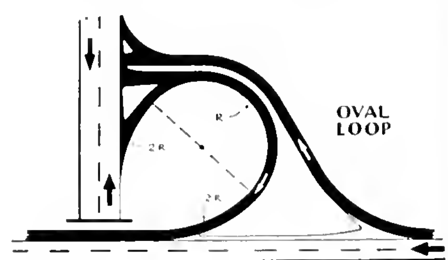


quently, the principal variation being a two-quadrant cloverleaf design. This design is used where the principal turning movements are in two quadrants, with only minor movements in the other two. The loops are arranged to eliminate left turns for the major movements while the minor movements are required to turn left across traffic on the cross facility. This type of design has been used successfully on many freeways throughout the country. Judgment must be used, however, in the design of the alignment of the loops.

Elongated loops sometimes fit the topography and developments more

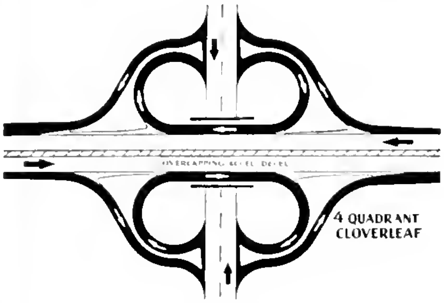


easily than circular or oval-shaped loops, but the short radius curves at each end of an intervening section of tangent are vulnerable to turning difficulties caused by the induced increased speed on the tangent section. From an operation standpoint, an oval-shaped loop, having curves at each end, whose radii are about double the radius of the central portion of the loop, induce more uniform operating speeds.



FOUR-QUADRANT CLOVERLEAF

A discussion of the advantages and disadvantages of some of the more common design patterns is now in order. The four-quadrant cloverleaf



design is probably most familiar, although its adaptability is rather limited. The chief advantage of the cloverleaf is that *all* left-turn conflicts are eliminated on both cross facilities. This type of design is particularly warranted where the turning movements are approximately equal in all quadrants and where the through traffic on the cross facility is heavy enough to warrant elimination of all left-turn movements.

The disadvantages of a four-quadrant cloverleaf frequently outweigh the advantages. This design requires extremely large areas of right of way for even moderate ramp connection design speeds, which makes it prohibitive in many highly developed areas. There is also an economic charge for circuity of travel where substantial turning volumes are to be accommodated. Another disadvantage of any cloverleaf loop is the necessity of driving beyond the inrersection and then

. . . Continued on page 60

James G. Standley

Continued from page 33 . . .

develop from 1914 to the present and played an important role in that development."

In May, 1929, Jim was transferred to headquarters in Sacramento as assistant maintenance engineer and served in this capacity until January 1, 1931. At this time he was transferred to the State Highway Engineer's Office to be in charge of personnel and organizational matters. He continued in this assignment until his retirement.

He became widely acquainted not only with the Division of Highways personnel throughout the State, but with representatives of labor organizations, the State Personnel Board and its staff, and representatives of other state agencies. For many years he served as a member of the Board of Review of Contractors' Claims, and has a wide acquaintanceship among highway contractors.

Jim received almost all grievances from state-wide highway employees and earned their confidence. He instigated continuing salary surveys and was able to convince the Personnel Board by logical presentation of facts of the equity of many salary increases. As a matter of fact, his salary increase presentations were watched and followed by other state agencies.

"The Division of Highways is a great outfit. We who have retired hate to leave it," says Jim.

STATE MERIT AWARD PROGRAM

To the Employees of the Department of Public Works

Each and every employee of the Department of Public Works is urged to participate in the State Merit Award (Employee Suggestion) Program, which is being inaugurated pursuant to legislative authorization.

This is an opportunity for employees to contribute to more efficient government through suggestions that reduce of eliminate expenditures. Each of you may be assured your ideas will receive careful consideration by a broadly representative committee, which in turn will refer your proposals to qualified personnel for comprehensive study.

I am asking the chief of each division to give this program his wholehearted support and to designate one of his immediate assistants to actively sponsor and stimulate this effort. I want every employee to have an opportunity to demonstrate his interest in improving our working methods and our service to the public.

We know that many of you have good ideas—let's be "suggestion conscious" and don't forget the cash awards!

C. H. PURCELL, Director of Public Works

WHAT IS THE STATE MERIT AWARD PROGRAM?

It is a program authorized by the Legislature to compensate employees by CASH AWARDS for suggestions that are adopted by the State, which make possible an elimination or reduction of state expenditures. If the adopted suggestion does not merit a cash award, the suggester will receive a letter or certificate of commendation.

WHO IS ELIGIBLE?

Every employee of the Department of Public Works is eligible to participate in this program—every employee of the State of California, as a matter of fact.

WHERE SHOULD SUGGESTION BE SENT?

A self-explanatory "Employee Suggestion Form" has been prepared, which also serves as a self-addressed envelope, which is addressed to:

State Merit Award Board
1020 N Street
Sacramento 14, California

A supply of these forms have been sent to each office of the Department of Public Works, so just ask your supervisor for your copy.

CAN MORE THAN ONE SUGGESTION BE SUBMITTED?

Yes, you may submit as many as you have ideas, although there is a limit of 10 awards that can be made to any agency in any year.

ARE THERE ANY RESTRICTIONS ON SUGGESTIONS?

Only that the suggestion must be outside the scope of your normal job responsibilities to be eligible for a cash award.

DOES THE IMMEDIATE SUPERVISOR OF AN EMPLOYEE HAVE TO APPROVE ANY SUGGESTION THAT IS SUBMITTED?

No, you may submit your suggestion directly to the Merit Award Board, and it will be forwarded without personal identification to the person or persons qualified to determine its feasibility.

WHO ARE MEMBERS OF THE MERIT AWARD BOARD?

The Merit Award Board has been appointed by the State Board of Control and is composed of five members: a representative of the Department of Finance, a member of the State Employees' Association, a representative of the Personnel Board, an employee at the supervisory level, and an employee at the nonsupervisory level.

HOW ARE THE SUGGESTIONS CONSIDERED?

Your suggestion goes first to the Merit Award Board and then is referred at once to a state agency or agencies for consideration. Within 30 days the agency reports its findings and recommendations to the board, along with the estimated cash savings from adoption of the idea.

The Merit Award Board will then evaluate the suggestion and determine the award.

DO THE SUGGESTIONS HAVE TO COVER ALL TECHNICAL POINTS?

No, however enough information must be furnished to allow the proper consideration of the idea on its own merits. You must make some outline of the method of procedure by which your idea can be put into practice. Be as thorough as possible.

WHEN DOES THE PROGRAM START?

Right now! See your employee's magazines and bulletin boards for further details—or ask your supervisor—NOW IS THE TIME FOR YOU TO OFFER YOUR SUGGESTIONS!

Kennedy New Secretary of Highway Body

Born in Wisconsin, educated in Oregon and a citizen of California since 1916, R. C. "Cass" Kennedy is the new Secretary of the California Highway Commission.

R. C. (CASS) KENNEDY

Named Rolland Cashel by his doting mother, he got dubbed Cassiday while a freshman at the University of Oregon. That was soon shortened to "Cass" and few of his hundreds of friends really know what his real name is.

Kennedy was educated as an electrical engineer and followed engineering for a number of years but broke away from the profession to do many other things. For years he was part of the automotive department of the Oakland *Tribune*. As such he was continually boosting good roads and making the Motorlog trips for the *Tribune*.

But he branched out for himself as a public relations and advertising man and has had his own business as a free lance writer for a number of years.

During World War I Kennedy was in the Army and when World War II came along he signed up with Lockheed Aircraft Corporation and was there for the duration. After VJ day a couple of years were spent in San Diego in the industrial relations field. But Northern California called and back to Oakland he came.

And from there he came to Sacramento as Secretary of the California Highway Commission.

Kennedy is married and boasts that he has had the same wife all the time. A son in Los Angeles and a daughter in Massachusetts have, between them, made him a grandfather three times—but you would never know it to watch him in action.

Carter Honored by Traffic Institute

F. M. Carter, Senior Highway Engineer of the Division of Highways, at the recent New York convention of the Institute of Traffic Engineers was elected a member of the Board of Direction.

The institute is a national organization of the outstanding traffic engineers and leading authorities, not only from the United States but from many other countries, on the design of and traffic operation on streets and highways.

The institute sponsored and assisted in producing the Manual on Traffic Control Devices, through which uniformity is being obtained in all the states.

Organized 20 years ago, its influence in traffic operation and safety is evidenced by the inclusion of its members on all national committees concerning traffic operation and safety.

The institute, in the interest of traffic safety and advancement of the profession of traffic engineering, sponsors annual awards to those states and cities showing outstanding achievements in traffic engineering during the year. California received this award in 1948.

Maintenance Men And Patrolmen Are Honored

Heads of some of the largest motor carrier organizations in the West put on white aprons on the afternoon of August 26th and cooked steaks, served refreshments and otherwise acted as hosts at a barbecue honoring more than 150 California State Highway maintenance employees and highway patrolmen. The event, sponsored by the Western Highway Institute, took place in Bear Valley, near Emigrant Gap, at picnic grounds loaned for the occasion by the Pacific Gas and Electric Company.

The party began at 3 p.m. and lasted until dusk, giving the various groups represented a chance to become acquainted with each other. These included, besides the guests of honor, representatives from many of the principal motor carrier organizations operating regularly over Highway U. S. 40, from the Western Conference of Teamsters, and from manufacturers of motor truck equipment. Total attendance exceeded 175.

There were no speeches, with the exception of a very brief greeting by John L. Springer, president of W. H. I., who gave recognition to the work being done by state highway employees, especially during winter, in keeping Highway U. S. 40 safe for traffic.

Among the guests were R. B. Millard and E. L. Miller of the California Department of Public Works in Sacramento, and Chief E. Raymond Cato and Captain Thad J. Douarin of Highway Patrol headquarters in the state capitol. Also attending were R. I. Nicholson, District Maintenance Engineer from Marysville, Captain George Peterkin of the patrol office in Roseville, and Tom Buell, head of the highway maintenance division at Truckee.

Another group of prominent guests came over from Reno, Nev., to attend the outing. These included: Chief Ed Gily of the Nevada Highway Patrol; G. F. Armstrong, maintenance superintendent of the Nevada High-

UPPER—Scene at barbecue in Bear Valley. LOWER—Barbecue cooks, Hal Kern, left, Chief E. Raymond Cato, California Highway Patrol, right

way Department; and Matt Walsh, J. L. Hancock, and W. H. Gibson, all Nevada Highway Department engineers.

The Western Highway Institute committee in charge of arrangements was headed by Jos. A. Gritsch, of the Oregon - Nevada - California Fast Freight, Inc., San Francisco, as chairman; Tony Lombardi, Western Truck Lines, Los Angeles, Cal., and Howard A. Wells, Wells Cargo, Reno, Nev. They were assisted by H. A. Kern, Bekins Van Lines, San Francisco; Wm. S. Darnell, Redding Trucking Service, Redding, Cal., and L. M. Jenkins, J. T. Jenkins Co., San Francisco.

Motor carrier organizations affiliated with the Western Highway Institute who sponsored the barbecue included Bigge Drayage Co., Oakland; Consolidated Freightways, Inc., Portland; Fortier Transportation Co., Fresno; Garrett Freightlines, Inc., Pocatello; Inland Freight Lines, Salt Lake City; Interstate Motor Lines, Inc., Salt Lake City; Kentner Truck Line, Inc., San Francisco; Lang Transportation Corp., Los Angeles; North American Van Lines, Inc., Fort Wayne; Oregon-Nevada-California Fast Freight, Inc., San Francisco; Pacific Intermountain Express, Inc., Oakland; F. N. Rumbley Co., Fresno; Sacramento Freight Lines,

. . . Continued on page 63

HIGHWAY BIDS AND AWARDS

July, 1950

KERN COUNTY—Over the tracks of the Southern Pacific Company at Oil Junction the existing steel bridge to be cleaned and painted. District VI, Route 4, Section G. R. W. Reade and Co., Berkeley, $3,429; The O'Connor Rustproofing Co., Los Angeles, $5,950. Contract awarded to Acme Spray Painters, Long Beach, $2,840.

KERN COUNTY—Between Isabella Dam Site and Route 57, about 1.9 miles to be graded and surfaced with imported base material bituminous surface-treated and reinforced concrete and structural steel bridge to be constructed. District VI, Route 142, Section F. Dimmitt and Taylor, Monrovia, 233,466; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $271,505; J. A. Payton, Riverside, $326,657; Rexroth and Rexroth, Bakersfield, $329,849; Frederickson and Kasler, Sacramento, $331,290. Contract awarded to Dix-Syl Construction Co., Inc., Bakersfield, $217,743.

LOS ANGELES AND ORANGE COUNTIES—Over Alamitos Bay in the City of Long Beach and over the Santa Fe Railway tracks at Irvine, two steel bridges to be cleaned and painted. District VII, Routes 60, and 2, Section L Bch, B. Contract awarded to Acme Spray Painters, Long Beach, $3,726.

LOS ANGELES COUNTY—On Rosemead Boulevard, at Ramona Freeway interchange area, furnish and install highway lighting system. District VII, Route 168, Section C. C. D. Draucker, Inc., Los Angeles, $14,470; Clinton Electric Corp., Los Angeles, $14,633; Electric and Machinery Service, Inc., South Gate, $14,888. Contract awarded to Newbery Electric Corp., Los Angeles, $10,410.

MENDOCINO COUNTY—Across Alder Creek and Greenwood Creek, about 9 and 20 miles north of Point Arena, respectively. District I, Route 56, Sections B, C. D. E. Burgess Co., San Francisco, $4,344. Contract awarded to R. W. Reade and Co., Berkeley, $2,578.

MODOC COUNTY—In the Town of Cedarville. District II, Route 28, Section C. C. C. Gildersleeve, Nevada City, $14,985. Contract awarded to Rand Construction Co., Bakersfield, $13,875.

MONTEREY COUNTY — Across the Salinas River at Bradley, existing steel bridge to be cleaned and painted. District V, Route 2, Section I. Williams and Kelly, Los Angeles, $13,870; R. W. Reade Co., Berkeley, $16,990; D. E. Burgess Co., San Francisco, $17,596; The O'Connor Rustproofing Co., Los Angeles, $19,942. Contract awarded to Allied Painters and Decorators, Inc., Oakland, $11,376.

MONTEREY COUNTY—At the Del Monte Junction, in the City of Monterey, furnishing and installing highway lighting system. District V, Routes 56, 117. R. Flatland, San Mateo, $2,800; Louis Electric Co., Salinas, $3,100; Granite Construction Co., Watsonville, $4,844. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $2,495.

RIVERSIDE COUNTY—Across Almar Ditch about one-half mile north of Oasis. District XI, Route 26, Section G. E. G. Perham, Los Angeles, $25,962; Anderson Co., Visalia, $26,152; W. J. Disteli, Los Angeles, $28,204; J. E. Haddock, Ltd., Pasadena, $29,397; E. S. and N. S. Johnson, Fullerton, $31,655; E. L. Thornsten, Santa Monica, $36,-960; Walter H. Barber and H. R. Breeden, La Mesa, $41,641. Contract awarded to C. B. Tuttle Co., Long Beach, $25,891.

SACRAMENTO COUNTY—On 16th Street, between Broadway in Sacramento and 12th Street north of Sacramento, about 2.3 miles, plant-mixed surfacing to be placed on existing pavement. District III, Routes 4, 3, Section B. J. B. Reeves, Sacramento, $35,010; A. Teichert and Son, Inc., Sacramento, $35,228; McGillivray Construction Co., Sacramento, $37,940. Contract awarded to Brighton Sand and Gravel Co., Sacramento, $34,830.

SACRAMENTO COUNTY—Across San Joaquin River, about 5 miles north of Antioch, the fenders of the existing bridge to be repaired. District X, Route 11, Section C. Healy Tibbits Construction Co., San Francisco, $24,122; Ben C. Gerwick, Inc., San Francisco, $28,651; The Duncanson-Harrelson Co., Richmond, $28,776; M. B. McGowan, Inc., San Francisco, 32,191. Contract awarded to Howard F. Lauritzen, Pittsburg, $19,479.

SACRAMENTO COUNTY—Across American River, near Elvas, about 1 mile northeast of Sacramento, the substructure for a bridge and portion of north embankment to be constructed. District III, Route 98, Section B. Erickson Phillips and Weisberg, Oakland, $623,191; Bates and Rogers Construction Co., San Francisco, $682,320; C. B. Tuttle Co., Long Beach, $684,022; Underground Construction Co., Oakland, $697,290; Granite Construction Co., Watsonville, $724,168; George Pollock Co., Sacramento, $756,882; Charles MacClosky Co., and Harms Bros., San Francisco, $771,918; United Concrete Pipe Corp., and Ralph A. Bell, Baldwin Park, $784,804; A. Teichert and Son, Inc., Sacramento, $792,840; Guy F. Atkinson, South San Francisco, $794,310; John C. Gist, Sacramento, $842,292; Walsh Construction Co., San Francisco, $871,913. Contract awarded to Lord and Bishop, Sacramento, $608,569.

SAN DIEGO—In the City of San Diego, Pacific Highway, between Couts Street and Rosecrans Street, about 0.7 mile to be graded and surfaced with plant-mixed surfacing. District XI, Route 2. Griffith Co., Los Angeles, $54,464; R. E. Hazard Contracting Co., San Diego, $59,897; V. R. Dennis Construction Co., San Diego, $62,583; Daley Corporation, San Diego, $63,768. Contract awarded to Cox Bros. Construction Co., Stanton, $52,965.

SAN DIEGO COUNTY—In the City of Oceanside, on Mission Avenue, between Horne Street and Canyon Drive, about 0.7 mile, bituminous surfacing treatment to be applied to portion of existing roadway. District XI, Route 195. E. S. and N. S. Johnson, Fullerton, $45,180; Cox Bros. Construction Co., Stanton, $49,491; Ralph R. Slaughter, Julian, $58,-006. Contract awarded to Arthur A. Johnson, Laguna Beach, $40,063.

SAN FRANCISCO COUNTY—On Funston Avenue, between West Pacific Avenue and Junction Route 2 in City of San Francisco. District IV, Route 56. R. W. Reade and Co., Berkeley, $4,995; Giampolini and Co., San Francisco, $5,335; Russell Hinton Co., San Francisco, $5,474; Martin Fried, San Francisco, $8,398. Contract awarded to D. E. Burgess Co., Colma, $4,809.

SAN LUIS OBISPO AND MONTEREY COUNTIES—Across Pico Creek and Little Pico Creek, about 4 miles north of Cambria, and across Limekiln Creek, about 2 miles south of Lucia, three existing steel bridges to be cleaned and painted. District V, Route 56, Sections B, C. Allied Painters and Decorators, Inc., Oakland, $16,674; G. C. Hewitt and Co., Ltd., Los Angeles, $20,653; R. W. Reade and Co., Berkeley, $25,488. Contract awarded to Acme Spray Painters, Long Beach, $11,369.

SANTA CLARA COUNTY—Between Palo Alto and Sunnyvale, about 5.9 miles, constructing additional roadway width by constructing plant-mixed surfacing on cement treated base and placing plant-mixed surfacing on portions of the existing pavement. District IV, Route 2, Section A, MVw. Leo F. Piazza Paving Co., San Jose, $375,263; A. J. Raisch Paving Co., San Jose, $379,529; Chas. L. Harney, Inc., San Francisco, $397,672; Clements and Co., Hayward, $410,234; A. Teichert and Son, Inc., Sacramento, $418,560; Granite Construction Co., Watsonville, $442,321. Contract awarded to Frank B. Marks, Jr., Newman, $367,478.

SANTA CRUZ COUNTY—Across Blooms Creek about 23 miles N.W. of Santa Cruz in Big Basin Redwoods State Park; a timber and log bridge to be constructed. District IV. Granite Construction Co., Watsonville, $4,899; Huettig, Schromm and Bennett, Palo Alto, $6,661. Contract awarded to Leo F. Piazza Paving Co., San Jose, $4,556.

SIERRA, NEVADA, AND PLACER COUNTIES—Across North Fork Yuba River, 3.9 miles north of Yuba County line. North Fork of North Fork Yuba River at Downieville, over Southern Pacific Rail Road Co. tracks, 4 miles east of Emigrant Gap, and across Bear River, 9 miles north of Auburn, four existing steel bridges to be cleaned and painted. District III, Routes 25, 37, and 17, Sections A, A, C. Allied Painters and Decorators, Inc., Oakland, $14,-864. Contract awarded to R. W. Reade and Co., Berkeley, $14,790.

SONOMA COUNTY—At various locations between Healdsburg and Santa Rosa and at Sonoma, about 6.4 miles to be graded and surfaced with plant-mix surfacing. District IV, Routes 1 and 51, Section B. James R. Armstrong, El Cerrito, $149,-567; Lee J. Immel, San Pablo, $160,061; J. Henry Harris, Berkeley, $185,813. Contract awarded to A. G. Raisch Co., San Rafael, $148,749.60.

SONOMA, SAN MATEO, SANTA CLARA, AND SAN JOAQUIN COUNTIES—District IV, various locations, sealing pavement joints. Contract awarded to Concrete Pavement Maintenance Co., San Francisco, $37,994.

SUTTER COUNTY—On the Sutter Causeway about 12 miles north of Knights Landing, about 1.0 miles to be surfaced with plant-mix surfacing and applying seal coat. District III, Route 87, Section B. Contract awarded to Rice Bros., Inc., Marysville, $14,478.

TULARE COUNTY—At the intersection of Mineral King Avenue with Mooney Boulevard in Visalia, a full traffic actuated signal system and highway lighting to be furnished and installed. District VI, Routes 10, 132, Section B. C. D. Draucker, Inc., Los Angeles, $13,746; L. H. Leonardi Electric Construction Co., San Rafael, $14,999; R. O. Ferguson Co., Visalia, $16,489. Contract awarded to Westates Electrical Construction Co., Los Angeles, $13,301.

YUBA COUNTY—Between Marysville and Butte County line (portions) at mile 1.8, mile 2.8, and mile 3.8 about 0.7 mile to be graded, imported, subbase material and crusher run base to be placed and surfaced with plant-mix surfacing. District III, Route 87, Section A. H. Earl Parker, Inc., Marysville, $34,581. Contract awarded to Rice Brothers, Inc., Marysville, $31,142.

Federal Aid Secondary County Highways

ALAMEDA COUNTY—Between Alvarado and 3 miles southeasterly, portions about 2.8 miles in length, constructing a graded roadbed, placing imported subbase material and crusher run base, and surfacing with plant-mix surfacing. District IV, Route 1025. Eugene G. Alves, Pittsburg, $164,870; Silva Brothers, Hayward, $169,227; Harms Bros., Sacramento, $194,532; J. Henry Harris, Berkeley, $210,081. Contract awarded to Clements and Co., Hayward, $159,852.

GLENN COUNTY—Between 4.7 miles east of U. S. 99 W. and State Route 45 at Four Corners, about 5.1 miles to be graded and surfaced with imported base material. District III, Route 1121. Browne and Krull, Hayward, $47,831; W. H. O'Hair Co., Colusa, $51,582; Volpa Brothers, Fresno, $51,-688; Nevada Constructors, Inc., Reno, $53,464; Baker Trucking Co., Hamilton City, $54,753; Harms Bros., Sacramento, $58,267; P. J. Moore and Son, North Sacramento, $61,049; McGillivary Construction Co., Sacramento, $63,310; O'Connor Bros., Red Bluff, $64,713; Eugene G. Alves, Pittsburg, $66,-381; H. Earl Parker, Inc., Marysville, $67,762; C. M. Svar, Vallejo, $85,171. Contract awarded to Westbrook and Pope, Sacramento, $47,155.

HUMBOLDT COUNTY—Between 0.7 mile east of Fortuna City Limits and Hydesville (portions), about 3.3 miles to be graded and surfaced with road-mix surfacing on imported base material constructed on imported subbase material. District I, Route 975. John Burman and Sons, Eureka, $84,259; C. M. Svar, Vallejo, $92,952; Tyson and Watters, Inc., Sacramento, $99,565. Contract awarded to Mercer Fraser Co. and Mercer Fraser Gas Co., Inc., Eureka, $84,092.

SAN DIEGO COUNTY—Between Cabrillo Freeway in the City of San Diego and Fairmount Extension, about 3.7 miles to be graded and surfaced with plant mixed surfacing on cement-treated base to provide a four-lane divided highway. District XI, Route 732, and City Streets. Fredericksen and Kasler, Sacramento, $704,255; R. E. Hazard Contracting Co., C. G. Willis and Sons, Inc., San Diego, $704,785; Peter Kiewit Sons Co., Arcadia, $767,190; N. M. Ball Sons, Berkeley, $780,444; Clyde W. Wood and Sons, Inc., North Hollywood, $789,375; Cox Bros. Construction Co., and J. E. Haddock, Ltd., Pasadena, $823,563; Daly Corporation, San Diego, $923,530. Contract awarded to Griffith Co., Los Angeles, $691,205.

SOLANO COUNTY—Between Vanden and Vacaville and between Vacaville and Elmira, about 2.4 miles in length; about 0.7 mile to be graded and surfaced with plant-mix surfacing placed on untreated rock base constructed on imported borrow; and about 1.7 miles to be graded and surfaced with untreated rock base constructed on imported borrow. District X, Routes 1107 and 1108. Browne and Krull, Hayward, $73,462; Harms Bros., Sacramento, $73,645; Karl C. Harmeling, Stockton, $74,428; Eugene G. Alves, Pittsburg, $80,514; Asta Construction Co., Rio Vista, $81,074; Warren and Drayer, Oakland, $85,423. Contract awarded to Fredrickson Bros., Emeryville, $71,377.10.

STANISLAUS COUNTY—Between City of Oakdale and Town of Waterford, about 9.5 miles, existing pavement to be widened with borders of untreated rock base, plant-mix surfacing to be placed on existing pavement and new base and bituminous surface treatment to be applied to shoulders. District X, Route 904. River Rock, Inc., Merced, $95,563; M. J. Ruddy and Son, Modesto, $99,376; Frank B. Marks, Jr., Newman, $104,669; Munn and Perkins, Modesto, $121,591. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $92,691.

STANISLAUS COUNTY—Between Turlock and Crows Landing Road, and between Monte Vista Avenue and Turlock, about 9.0 miles, the existing roadbed to be widened with untreated rock base and resurfaced with plant-mix surfacing. District X, Routes 916 and 914. Frank B. Marks, Jr., Newman, $88,474, River Rock, Inc., Merced, $93,813; M. J. Ruddy and Son, Modesto, $93,880. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $84,903.70.

STANISLAUS COUNTY—Between Modesto and 5.4 miles westerly, about 5.4 miles, existing pavement to be widened with borders of untreated rock base, plant-mix surfacing to be placed on existing pavement and new base, and penetration treatment to be applied to shoulders. District X, Route 917. M. J. Ruddy and Son, Modesto, $70,745; River Rock, Inc., Merced, $70,919; Munn and Parkins, Modesto, $73,017; Valley Paving and Construction Co., Inc., Pismo Beach, $78,854. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $66,876.

August, 1950

AMADOR COUNTY—Between Silver Lake and Alpine County Line, about 3.6 miles, to be graded, surfaced with imported surfacing material on imported base material and bituminous surface treatment and seal coat to be applied. District X, Route 34, Section H. Contract awarded to Harms Bros., Sacramento, $226,035.

BUTTE COUNTY—Between Biggs Road and Route 3, about 2.0 miles to be graded and gravel base material placed. District III, Route 45, Section A Rice Brothers, Inc., Marysville, $34,712. O'Connor Bros., Red Bluff, $35,274; Baker Trucking Co., Hamilton City, $35,592; J. P. Brennan, Redding, $39,354; Miles and Bailey, Madera, $42,144. Contract awarded to Eugene G. Alves, Pittsburg, $33,656.

CONTRA COSTA COUNTY—Portions between Monument and Concord, a net distance of about 2.1 miles to be graded and surfaced with plant-mixed surfacing. District IV, Route 75, Section B. Parish Brothers, Benicia, $108,391; Lee J. Immel, San Pablo, $112,638. J. Henry Harris, Berkeley, $121,864. Contract awarded to J. R. Armstrong, El Cerrito, $107,098.84.

DEL NORTE COUNTY—At Hunter Creek, about 2.4 miles north of Klamath, an existing bridge to be removed and a new reinforced concrete slab type bridge to be constructed and approaches thereto to be graded and surfaced with plant mixed surfacing. District I, Route 1, Section A. Contract awarded to Harms Brothers and C. M. Syar, Sacramento, $84,362.

HUMBOLDT COUNTY—At Salt River, about three miles southwest of Fernbridge, a bridge and approaches to be constructed. District 1, Route 56, Section A. Contract awarded to Mercer Fraser Co., and Mercer Fraser Gas Co., Inc., Eureka, $109,910.60.

LOS ANGELES—In the City of Redondo Beach at the intersection of Pacific Coast Highway with Avenue "F," traffic signal system to be furnished and installed. District VII, Route 60. Electric and Machinery Service, Inc., South Gate, $2,249; Ed Seymour, Long Beach, $2,274; Clinton Electric Corp., Los Angeles, $2,389. C. D. Draucker, Inc., Los Angeles, $2,474; Westates Electrical Construction Co., Los Angeles, $2,478. E. D. Johnson, Anaheim, $2,553. Contract awarded to Fischbach and Moore of California, Los Angeles, $2,173.

LOS ANGELES COUNTY—In the City of Los Angeles install sprinkling system, plant grass, trees and shrubs and install plant boxes in light well, at District Office Building. District VII. Moulder Bros., Glendale, $2,758; James E. Boothe, Lynwood, $3,335; Henry C. Soto Corp., Los Angeles, $3,341. Contract awarded to Jannoch Nurseries, Altadena, $2,310.30.

LOS ANGELES COUNTY—On Foothill Blvd., between Sierra Madre Villa Ave. and Michillinda Ave., about 0.8 mile to be graded and surfaced with plant mixed surfacing on cement treated base and existing pavement. District VII, Route 9, Section Pas, E. Vido Kovacevich Co., South Gate, $80,799; H. and H. Construction Co., Long Beach, $81,372; Warren Southwest, Inc., Torrance, $86,634. Griffith Company, Los Angeles, $92,675. Contract awarded to J. E. Haddock, Ltd., Pasadena, $78,924.

LOS ANGELES COUNTY—Over Harbor Freeway at Fourth Street, in the City of Los Angeles, a reinforced concrete box girder bridge to be constructed and road connections to be graded and paved. District VII, Route 165. K. B. Nicholas, Ontario, $529,140; J. E. Haddock, Ltd., Pasadena, $539,784; Webb and White, Los Angeles, $549,680; Oberg Bros. Construction Co., Inglewood, $560,978; Winston Bros. Co., Monrovia, $565,083; Carlo Bongiovanni, Hollywood, $566,690. Guy F. Atkinson Co., Long Beach, $598,760; Peter Kiewit Sons Co., Arcadia, $605,492; Charles MacClosky Co., San Francisco, $608,687. Contract awarded to W. J. Disteli, Los Angeles, $512,854.10.

LOS ANGELES AND VENTURA COUNTIES—Between 2 miles east of Los Angeles-Ventura County Line and 1 mile west of Moorpark Road, about 7.1 miles in length to be graded and surfaced with plant-mixed surfacing on untreated rock base. District VII, Route 2, Sections C, A. Peter Kiewit Sons Co., Arcadia, $928,642; Clyde W. Wood and Sons, Ins., North Hollywood, $980,884; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $1,032,019; Cox Bros. Construction Co. and J. E. Haddock, Ltd., Pasadena, $1,033,008. Winston Bros. Co., Monrovia, $1,046,691; Dimmitt and Taylor and T. M. Page, Monrovia, $1,053,051; Claude Fisher Co., Ltd., Los Angeles, $1,054,266. H. and H. Construction Co. and Hess Construction Co., Inc., Long Beach, $1,074,813. Griffith Co., Los Angeles, $1,144,493; Basich Bros. Construction Co. and R. L. Basich and N. L. Basich, San Gabriel, $1,164,902; Tomei Construction Co., Van Nuys, $1,197,405. Contract awarded to Fredericksen and Kasler, Sacramento, $823,334.65.

LOS ANGELES COUNTY—At the junction of Route 4 with Route 79 at Saugus Junction and at Castaic Junction, located approximately 8 miles and 9.6 miles northerly of the north city limits of Los Angeles, respectively, sprinkling systems to be installed. District VII, Routes 4, 79, Sections F, A, B, A. United Sprinkler Co., Los Angeles, $6,147; Forrest C. Cleveland, Los Angeles, $6,489; D. and M. Sprinkler Co., Long Beach, $6,589; Henry C. Soto Corp., Los Angeles, $8,606. Delno E. Hall, Arcadia, $9,509. Contract awarded to Jannoch Nurseries, Altadena, $5,876.

MADERA COUNTY—Between 1.5 miles north of Madera and 0.3 mile north of Dry Creek, about 3.7 miles to be graded and paved with Portland cement concrete on cement treated subgrade and plant mixed surfacing on untreated rock base, and a reinforced concrete slab bridge to be constructed on concrete pile bents, District VI, Route 4, Section B. Harms Bros., Sacramento, $444,986; Griffith Co., Los Angeles, $447,804. Contract awarded to Guy F. Atkinson Co., South San Francisco, $397,539.

MADERA COUNTY—In the City of Madera, at the intersection of Yosemite Avenue with "D" Street; a fixed time traffic signal system and highway lighting to be furnished and installed. District VI, Route 126. Robinson Electric, Fresno, $4,000; Westates Electrical Construction Co., Los Angeles, $4,817. Contract awarded to Clinton Electric Corp., Los Angeles, $3,746.

MENDOCINO COUNTY—In the City of Willits, between the South City Limits and North City Limits, about 1.6 miles, cement treated base and imported subbase material to be placed on portions and the entire length to be surfaced with plant-mixed surfacing. District 1, Route 1, Section Wlts. Contract awarded to Harms Bros. and C. M. Syar, Sacramento, $117,361.90.

MERCED COUNTY—Between Santa Clara County Line and 3.5 miles easterly, to be widened and surfaced with plant mixed surfacing on cement treated base. District X, Route 32, Section A. Clements and Co., Hayward, $134,772. Clyde W. Wood and Sons, Inc.; North Hollywood, $135,503; Granite Construction Co., Watsonville, $148,506; A. Teichert and Son, Inc., Sacramento, $149,473; Harms Bros., Sacramento, $150,928. Contract awarded to Munn and Perkins, Modesto, $128,902.

MONO COUNTY—Between Conway Summit and Topaz Lake, producing and stockpiling medium screenings. District IX, Routes 23, 95, Sections JK, A. Harms Bros., Sacramento, $33,100; Roland T. Reynolds, Anaheim, $59,700. Contract awarded to Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $27,900.

NAPA COUNTY—Between 1.5 miles and 4.5 miles south of Lake County Line, portions, about 2 miles in net length, to be surfaced with road-mixed surfacing and crusher run base. District IV, Route 49, Section A. Harold Smith, St. Helena, $69,792. J. Henry Harris, Berkeley, $69,864. Contract awarded to C. M. Syar, Vallejo, $52,552.50.

NAPA COUNTY—On Lincoln Road between Napa River and Foothill Boulevard in Calistoga, about 0.1 mile in length, curbs, gutters, and drainage facilities to be adjusted and plant-mixed surfacing to be placed on existing pavement. District IV, Route 49, Section Cstg. Slinsen Construction Co., Napa, $19,835; J. Henry Harris, Berkeley, $22,789. Contract awarded to Harold Smith, St. Helena, $17,879.

ORANGE COUNTY—In the City of Fullerton, at the intersections of Spadra Road with Amerige Avenue and with Union Avenue, traffic signal systems to be furnished and installed. District VII, Route 2. E. D. Johnson, Anaheim, $5,117; Clinton Electric Corp., Los Angeles, $5,160; C. D. Draucker, Inc., Los Angeles, $5,393; Westates Electrical Construction Co., Los Angeles, $5,427; Electric and Machinery Service, Inc., South Gate, $5,457. Contract awarded to Fischbach and Moore of California, Inc., Los Angeles, $4,659.

ORANGE COUNTY—On Manchester Avenue between Lincoln Avenue and Los Angeles Street, furnish and install full traffic actuated signal system at three intersections, furnish and install intersection lighting at three intersections and furnish highway lighting equipment for three intersections. District VII, Route 174, Sections Ana, A. Paul R. Gardner, Ontario, $35,042; Electric and Machinery Service, Inc., South Gate, $35,051; Clinton Electric Corp., Los Angeles, $35,630; Ets-Hokin and Galvan, Wilmington, $36,100. C. D. Draucker, Inc., Los Angeles, $36,857. Contract awarded to Westates Electrical Construction Co., Los Angeles, $34,909.

SAN JOAQUIN COUNTY—On State Route 4, between Mariposa Road and Waterloo Road, 3 traffic signal systems to be furnished and installed, and one state-furnished electrolier to be installed. District X, Route 4, Section E, C. R. Goold and Son, Stockton, $33,989; Clinton Electric Corp., Los Angeles, $34,246. Ets-Hokin and Galvin, Stockton, $37,776. Contract awarded to Westates Electrical Construction Co., Los Angeles, $31,974.

SAN MATEO COUNTY—At the intersection of Bayshore Highway with East Hillsdale Boulevard, a full traffic actuated signal system and highway lighting to be furnished and installed and channelization to be constructed. District IV, Route 68, Section C. Contract awarded to L. C. Smith, San Mateo, $18,559.

SANTA BARBARA COUNTY—Furnish and install highway lighting system at the Orcutt Wye, 1.9 miles south of the City of Santa Maria, District V, Route 2, Section L, N. E. H. Anderson, Santa Maria, $3,447; R. Flatland, San Mateo, $3,450; L. H. Leonardi Electric Construction Co., San Rafael, $3,499. Contract awarded to Westates Electrical Construction Co., Los Angeles, $3,199.

SANTA BARBARA COUNTY—Between Tequepis Canyon and one and one-half miles east of Santa Ynez River Bridge, about 3.3 miles to be graded and surfaced with plant-mixed surfacing on untreated rock base and seal coats to be applied. District V, Route 80, Section B. Fredericksen and Kasler, Sacramento, $355,332. Peter Kiewit Sons Co., Arcadia, $361,088; Dimmitt and Taylor and T. M. Page, Monrovia, $361,596; Eaton and Smith, San Francisco, $378,522; Granite Construction Co., Watsonville, $384,100; Valley Paving and Construction Co., Inc., Pismo Beach, $385,796; Clyde W. Wood and Sons, Inc., North Hollywood, $389,281. Roland T. Reynolds and Thomas Construction Co., Fresno, $392,342; J. A. Payton, Riverside, $404,-368. Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $408,548; Madonna Construction Co., San Luis Obispo, $421,929; Cox Bros. Construction Co. and J. E. Haddock, Ltd., Pasadena, $432,860; Claude Fisher Co., Ltd., Los Angeles, $451,332. Contract awarded to Kirst and Sons, Altadena, $346,940.16.

SANTA BARBARA COUNTY—Between 0.6 mile east of Arroyo Quemado and 0.7 mile west of Arroyo Hondo; between Jalama Road and Route 149, and between Orcutt Wye and Santa Maria, a net distance of about 8.9 miles, a Class "C-Fine" seal coat to be applied. District V, Routes 2, 56, Sections F; L. A. B. Madonna Construction Co., San Luis Obispo, $17,680; E. S. and N. S. Johnson, Fullerton, $19,126. Contract awarded to Valley Paving and Construction Co., Inc., Pismo Beach, $15,509.75.

SANTA CLARA COUNTY—On Bayshore Highway at Mathilda Aveune, a full traffic actuated signal system and highway lighting to be furnished and installed and channelization to be constructed. District IV, Routes 68, 114, Sections B, A. A. J. Raisch Pav. Co., San Jose, $18,950. Contract awarded to L. C. Smith, San Mateo, $18,132.

SOLANO, YOLO COUNTIES—Across Putah Creek, about 5 miles north of Dixon, the existing bridge to be repaired. District III, Route 7, Section E. A. D. M. Sandling, San Pablo, $13,940; G. C. Gildersleeve, Nevada City, $14,193. Contract awarded to Ben C. Gerwick, Inc., San Francisco, $10,395.

SONOMA COUNTY—Across Tolay Creek, about 0.1 mile east of junction of Routes 8 and 208, the existing bridge to be altered. District IV, Route 208, Section A. D. M. Sandling, San Pablo, $185,-007; Bigge Drayage Co., Oakland, $243,000; J. H. Pomeroy and Co., Inc., San Francisco, $375,000. Contract awarded to Thomas Rigging Co., Emeryville, $118,900.

VENTURA COUNTY—In San Buenaventura Beach State Park, about 0.64 mile, highway to be graded and surfaced with plant-mixed surfacing and a reinforced concrete bridge to be constructed. District VII. E. S. and N. S. Johnson, Fullerton, $59,-077; Baker and Pollock, Ventura, $60,307; E. G. Perham, Los Angeles, $61,441; H. C. Johnson, Long Beach, $64,061; Charles T. Richardson, Santa Barbara, $66,900. Byerts and Sons and George K. Thatcher, Los Angeles, $69,845; Covina Construction Co., Covina, $71,901. Contract awarded to C. J. B. Construction Co., Oxnard, $55,027.38.

YOLO COUNTY—On West Sacramento Freeway, over Yolo Causeway Off Ramp, about 4 miles west of Sacramento, a reinforced concrete slab bridge to be constructed. District III, Route 6, Section C. Lew Jones Construction Co., San Jose, $106,015; Continental Construction Co., Sacramento, $107,796. Dan Caputo, San Jose, $109,503; A. L. Miller, Sacramento, $111,136; H. W. Ruby, Sacramento, $114,-598; Fredrickson Brothers, Emeryville, $115,904. Chittenden and Chittenden and B. S. McElderry, Auburn, $116,115; R. G. Clifford, L. G. Lentz and C. O. Bodenhamer, South San Francisco, $118,646; Erickson, Phillips and Weisberg, Oakland, $120,214. Contract awarded to Charles MacClosky Co. and Harms Bros., San Francisco, $105,188.80.

Federal Aid Secondary County Highways

BUTTE COUNTY—Between Oroville and Oroville-Quincy Highway at Ward Boulevard, about 3.3 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District III, Route 759. McGillivray Construction Co., Sacramento, $134,339; A. G. Raisch Co., San Rafael, $141,816. Contract awarded to Rice Bros., Inc., Marysville, $129,542.10.

CONTRA COSTA COUNTY—On Byron Road between State Highway Route 75 and 1.6 miles southeasterly of Byron, about 3.2 miles existing roadbed to be widened. District IV, Route 610. Eugene G. Alves, Pittsburg, $91,298; Parish Bros., Benicia, $100,337; J. Henry Harris, Berkeley, $108,-105. Contract awarded to J. R. Armstrong, El Cerrito, $89,237.50.

EL DORADO COUNTY—Between Bell Ranch and 1.5 miles southeasterly, approximately 5 miles east of Diamond Springs, about 1.5 miles to be graded and penetration treatment and seal coat applied to imported borrow. District III, Route 1095. Paul E. Woof, Fresno, $54,894; Eugene G. Alves, Pittsburg, $55,009; Miles and Bailey, Madera, $55,-254; W. H. O'Hair Co., Colusa, $56,062; Thomas Construction Co., Fresno, $56,632; Harms Bros., Sacramento, $56,828; Nevada Constructors, Inc., Reno, $61,432; J. Henry Harris, Berkeley, $86,144. Contract awarded to John G. Mehren, Campbell, $41,791.50.

FRESNO COUNTY—On Jayne Avenue between Sacramento Avenue and Glenn Avenue, about 5 miles to be graded and surfaced with bituminous surface treatment. District VI, Route 808. Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $103,148. Rexroth and Rexroth, Bakersfield, $109,383; Ted F. Baun, Fresno, $112,008; Roland T. Reynolds and Thomas Construction Co., Fresno, $115,255; Covina Construction Co., Covina, $118,114. A. A. Edmondson, Glendale, $118,133; Anderson Co., Visalia, $119,318; Valley Paving and Construction Co., Inc., Pismo Beach, $121,048; Clyde W. Wood and Sons, Inc., North Hollywood, $122,861; Westbrook and Pope, Sacramento, $123,-086; Rand Construction Co., Inc., Bakersfield, $123,-447; Gerald E. Brewster, Avenal, $130,845; Miles and Bailey, Madera, $132,343; Gene Richards, Fresno, $133,884; Harms Bros., Sacramento, $135,-850; W. H. O'Hair Co., Colusa, $160,196. Contract awarded to Volpa Bros., Fresno, $102,009.50.

MENDOCINO COUNTY—On Willits-Fort Bragg Road, between 14 miles and 10 miles westerly of Willits, portions, a distance of about 4 miles to be graded and corrugated metal pipes to be installed. District I, Route 982. S. A. E. Co., Redwood City, $93,110; Parish Bros., Benicia, $105,762; Harold Smith, St. Helena, $120,240; Fredrickson and Watson Construction Co., Oakland, $120,260; M. Malfitano and Son, Inc., Louis Biasotti and Son, Inc., Pittsburg, $121,760; Piombo Construction Co., San Francisco, $127,045; Harms Bros., Sacramento, $128,-390; Stolte, Inc., Oakland, $149,605; Fredrickson Bros., Emeryville, $154,990; C. V. Kenworthy, Stockton, $169,968; Fred McKinley, Paramount, $171,631; Eugene G. Alves, Pittsburg, $176,585; Klein Smid Construction Co., and Frank Goodrick, Bakersfield, $191,620; J. P. Brennan, Redding, $246,750. Contract awarded to John Burman and Sons, Eureka, $89,580.

SONOMA COUNTY—Between 1.8 miles and 3.6 miles northwest of State Route 8, about 8 miles southeast of Petaluma, about 1.8 miles to be graded and surfaced with crusher run base on imported subbase material, and Class "B-Double" seal coat and penetration treatment applied. District IV, Route 878. Brown-Ely Co., Contractors, and E. A. Forde, Corte Madera, $113,597; Arthur B. Siri, Inc., Santa Rosa, $123,207; A. G. Raisch, San Rafael, $126,105; J. Henry Harris, Berkeley, $129,081; Nevada Constructors, Inc., Reno, $139,255. Contract awarded to Eugene G. Alves, Pittsburg, $119,889.

TEHAMA COUNTY—At Mill Creek and at McCarty Creek, respectively 11.5 and 18.1 miles west of Corning, two bridges to be constructed and at Willow Creek 16.9 miles west of Corning, an existing bridge to be widened, and a combined length of about 1 mile of approaches at the 3 bridges to be braded and surfaced with road-mixed surfacing. District II, Route 1078. Baker Trucking Co., Hamilton City, $106,802. Chittenden and Chittenden and B. S. McElderry, Auburn, $123,-441; O'Connor Bros., Red Bluff, $133,357; Eugene G. Alves, Pittsburg, $134,909; J. P. Brennan, Redding, $174,387. Contract awarded to H. W. Ruby, Sacramento, $106,546.50.

TULARE COUNTY—Between the east city limits of Dinuba and Orosi, a distance of about 4.8 miles, to be graded and surfaced with plant-mixed surfacing on existing pavement and on imported base material and bituminous surface treatment to be applied to portions of shoulders. District VI, Route 1142, Munn and Perkins, Modesto, $120,571; Valley Paving and Construction Co., Inc., Pismo Beach, $125,225; Volpa Bros., Fresno, $126,921; Ted F. Baun, Fresno, $130,157; George E. France, Inc., Visalia, $130,597; Covina Construction Co., Covina, $134,842; Gene Richards, Fresno, $137,264; Anderson Co., Visalia, $145,014; Guy F. Atkinson Co., South San Francisco, $163,396. Contract awarded to Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $112,450.

September, 1950

IMPERIAL COUNTY—Across New River, about 5 miles north of Brawley, a reinforced concrete slab bridge on concrete pile bents to be constructed and about 0.55 mile of roadway to be graded and surfaced with road-mix surfacing on imported base material. District XI, Route 187, Section D. Anderson Co., Visalia, $56,750; Walter Kaucher, Los Angeles, $57,413; Ralph B. Slaughter, Julian, $57,483; E. G. Perham, Los Angeles, $57,840; Walter H. Barber and H. R. Breeden, La Mesa, $59,585. Contract awarded to Norman I. Fadel, North Hollywood, $53,351.

LOS ANGELES COUNTY—In Arroyo Seco Park, over Arroyo Seco Channel, near Avenue 58, a prestressed concrete girder pedestrian bridge to be constructed. District VII, Route 205. J. E. Haddock, Ltd., Pasadena, $24,810; McClain Construction Co., Inc., Hawthorne, $42,280; Concrete Construction Service, Inc., Gardena, $46,811. Contract awarded to Walter Kaucher, Los Angeles, $23,770.

LOS ANGELES COUNTY—In the City of Glendale, at the intersections of Canada Boulevard with Wabasso Way, Del Valle Avenue, Glorietta Avenue, and Santa Maria Avenue-Country Club Drive, traffic signal systems and highway lighting to be furnished and installed. District VII, Route 61. Westates Electrical Construction Co., Los Angeles, $28,984; Clinton Electric Corporation, Los Angeles, $29,341; Electric and Machinery Service, Inc., South Gate, $29,963. Contract awarded to C. D. Draucker Inc., Los Angeles, $28,569.

LOS ANGELES COUNTY—Over Hollywood Freeway, at Belmont Avenue, a reinforced concrete pedestrian overcrossing to be constructed. District VII, Route 2. J. E. Haddock, Ltd., Pasadena, $31,-490. Contract awarded to Byerts and Sons, Los Angeles, $30,724.50.

LOS ANGELES COUNTY—In the City of Glendale, at the intersection of Canada Boulevard with Wabasso Way, Del Valle Avenue, Glorietta Avenue, and Santa Maria Avenue-Country Club Drive, traffic signal systems and highway lighting to be furnished and installed. District VII, Route 61. Westates Electrical Construction Co., Los Angeles, $28,984; Clinton Electric Corp., Los Angeles, $29,341; Electric & Machinery Service, Inc., South Gate, $29,963. Contract awarded to C. D. Draucker, Inc., Los Angeles, $28,569.

NEVADA COUNTY—At Donner Memorial State Park, near Truckee, bituminous surface treatment to be applied to existing Park roads and parking areas. District III. Miles and Bailey, Madera, $14,106; J. Henry Harris, Berkeley, $17,867. Contract awarded to Claude C. Wood Co., Lodi, $13,163.50.

RIVERSIDE COUNTY—At the intersection of Magnolia Ave., with Van Buren Street, in the City of Riverside, full traffic actuated signal system and highway lighting to be furnished and installed. District VIII, Route 43. Ets-Hokin and Galvan, Wilmington, $12,100; Westates Electrical Construction Co., Los Angeles, $11,961; C. D. Draucker, Inc., Los Angeles, $11,819; Clinton Electric Corp., Los Angeles, $11,783. Contract awarded to Paul R. Gardner, Ontario, $11,515.

SAN BERNARDINO COUNTY—Between 0.3 mile south of the south city limits of Ontario and Desau Street, about 1.4 miles, construct a graded roadbed for a channelized intersection and construct plant-mix surface on imported base material, placing plant mix surfacing over the existing pavement and applying seal coats. District VIII, Route 192. Section A. Griffith Co., Los Angeles, $31,264; E. L. Yeager

Co., Riverside, $35,802; R. A. Erwin, Colton, $42,-560. Contract awarded to Cox Brothers Construction Co., Stanton, $27,448.

SAN LUIS OBISPO COUNTY—At California State Polytechnic College, tennis courts to be graded and surfaced with portland cement concrete and walkways and basketball and volleyball courts to be graded and surfaced with plant mix surfacing. District V. Tom C. Latham, Bakersfield, $32,143; O. R. Ochs and Son, San Luis Obispo, $41,293. Contract awarded to Madonna Construction Co., San Luis Obispo, $31,619.25.

SAN MATEO AND SANTA CLARA COUNTIES—On El Camino Real at Palo Alto Ave., a full traffic actuated signal system and highway lighting to be furnished and installed, channelization to be constructed, and existing electrical material to be removed. District IV, Route 2, Section MIP, PA, A. J. Henry Harris, Berkeley, $28,008. Contract awarded to A. J. Raisch Paving Co., San Jose, $27,677.50.

SANTA BARBARA COUNTY—In the City of Santa Barbara, at Salsipuedes Street and between Bath Street and Junipero Street, about 2.3 miles, an off ramp to be graded and surfaced with plant-mix surfacing on crusher run base and existing pavement to be widened on both sides with plant-mix surfacing on cement treated crusher run base. District V, Route 2. Madonna Construction Co., San Luis Obispo, $111,336; Baker and Polock, Ventura, $116,317; Valley Paving and Construction Co., Inc., $120,335. Contract awarded to N. M. Ball Sons, Berkeley, $110,935.50.

SANTA BARBARA COUNTY—Between Hot Springs and Tequepis Canyon, about 4 miles to be graded and surfaced with plant-mix surfacing on untreated rock base and seal coat to be applied. District V, Route 80, Section B. Clyde W. Wood and Sons Inc., North Hollywood, $55,624; Eaton and Smith, San Francisco, $574,076; Dimmitt and Taylor and T. M. Page, Monrovia, $576,576; Oilfield Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $578,603; Granite Construction Co., Watsonville, $597,857; McKinley and Kirk Construction Co., Paramount, $599,034; Madonna Construction Co., San Luis Obispo, $601,221; A. H. Famularo and Roland T. Reynolds, Anaheim, $602,499; Cox Brothers Construction Co., and J. E. Haddock Ltd., Pasadena, $660,175; M. J. B. Construction Co., Stockton, $670,202; Guy F. Atkinson Co., South San Francisco, $692,708; N. M. Ball Sons, Berkeley, $712,957; Peter Kiewit Sons' Co., Arcadia, $725,-348. Contract awarded to J. A. Peyton, Riverside, $548,439.

YOLO COUNTY—On Merkeley Avenue between Jefferson Blvd. and Park Blvd. for placing crusher run base and surfacing with plant-mix surfacing. District III, Route 6, Section C. Harms Brothers, Sacramento, $10,906; A. Teichert and Son, Sacramento, $11,152. Contract awarded to Brighton Sand and Gravel Co., Sacramento, $9,936.

Federal Aid Secondary County Highways

LASSEN COUNTY—Between Grasshopper Valley Ranch and Hayden Hill Road, about 12.8 miles, to be graded and surfaced with road-mixed surfacing on gravel base. District II, Route 988, Joint Highway District No. 14. Isbell Const. Co., Reno, $280,166; H. Earl Parker, Inc., Marysville, $306,290; Eaton and Smith, San Francisco, $324,435; Eugene G. Alves, Pittsburg, $332,797; Rand Construction Co., Inc., Bakersfield, $389,214; Chittenden and Chittenden, Auburn, $434,935; Harms Bros. and M. W. Brown, Sacramento, $368,770. Contract awarded to W. H. O'Hair Co., Colusa, $273,390.84.

SAN BERNARDINO COUNTY—Central Ave., between Foothill Blvd. and Phillips Blvd., about 4.1 miles to be graded and surfaced with plant-mix surfacing on imported base material. District VIII, Route 692. Griffith Co., Los Angeles, $189,183; George Herz and Co., San Bernardino, $207,656; Peter Kiewit Sons' Co., Arcadia, $210,823; J. A. Payton, Riverside, $217,431; Crox Brothers Construction Co., Stanton, $220,888; K. and H. Co., Colton, $226,182; Dimmitt and Taylor, Monrovia, $240,279; R. P. Shea Construction Co., Indio, $264,-693; E. L. Yeager Co., Riverside, $289,380; R. A. Erwin, Colton, $330,135. Contract awarded to Hess Construction Co., Inc., Long Beach, $175,172.90.

October, 1950

ALAMEDA COUNTY—On Eastshore Freeway between Lewelling Boulevard and 0.1 mile north of the south city limits of Oakland, about 4.2 miles to be graded and paved with portland cement concrete and plant-mixed surfacing and highway separation structures to be constructed. District IV, Route 69. Guy F. Atkinson Co., South San Francisco, $2,920,371; Peter Kiewit Sons' Co., Arcadia, $2,943,746; United Concrete Pipe Corp., Baldwin Park, $2,983,665; Harms Bros. and N. M. Ball Sons, Berkeley, $2,985,286; Fredrickson Bros. and Bates & Rogers Construction Corp., Emeryville, $3,078,-943; Fred J. Early, Jr., Co., Inc. and Stolte, Inc., Oakland, $3,171,044; Cox Bros. Construction Co. and J. L. Haddock, Ltd., Pasadena, $3,189,529; A. Teichert & Son, Inc., Sacramento, $3,190,356; Parish Bros. and A. Soda & Son, Benicia, $3,565,005; Chas. L. Harney, Inc., San Francisco, $4,293,092. Contract awarded to Fredrickson & Watson Construction Co. and M. & K. Corp., Oakland, $2,871,212.12.

BUTTE COUNTY—Across Oak Knob Draw, about 6.7 miles south of Oroville, a reinforced concrete bridge and approaches to be widened. District III, Route 87, Section A. Rice Brothers, Inc., Marysville, $7,316; O'Connor Bros., Red Bluff, $7,921; D. M. Sandling, San Pablo, $8,282. Contract awarded to C. C. Gildersleeve, Nevada City, $6,841.35.

EL DORADO COUNTY — Between Railroad Crossing east of Placerville and Five Mile Terrace west of Camino, about 2 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District III, Route 2, Sections D, E. A. Teichert & Son, Inc., Sacramento, $288,663; Harms Bros., Sacramento, $288,729; M. Malfitano & Son, Inc., Pittsburg, $314,675; Clyde W. Wood & Sons, Inc., North Hollywood, $337,448. Contract awarded to H. Earl Parker, Inc., Marysville, $272,079.75.

FRESNO COUNTY—Between 2 miles east of Monterey County line and 0.2 mile east of Hot Springs Canyon Road, portions, about 3.4 miles to be graded, bituminous surface treatment applied, and a reinforced concrete slab bridge to be constructed. District VI, Route 10, Sections A, B. Louis Biasotti & Son, Stockton, $192,840; Roland T. Reynolds and Thomas Construction Co., Fresno, $220,726; Claude Fisher Co., Ltd., Los Angeles, $224,442; McKinley & Kirk Construction Co., Paramount, $224,746; L. A. & R. S. Crow, El Monte, $229,180; Nevada Constructors, Inc., Reno, $233,-078; Westbrook & Pope, Sacramento, $234,482; Granite Construction Co., Watsonville, $236,446; Edward Keeble, San Jose, $236,654; Chittenden & Chittenden and B. S. McElderry, Auburn, $240,490; Dimmitt & Taylor and T. M. Page, Monrovia, $240,-615; Eugene G. Alves, Pittsburg, $249,465; Harms Bros., Sacramento, $266,209; Gerald E. Brewster, Avenal, $271,467; S. A. E. Co., Redwood City, $279,195; Anderson Co., Visalia, $285,875; Eaton & Smith, San Francisco, $287,341; Clyde W. Wood & Sons, Inc., North Hollywood, $300,115. Contract awarded to John F. Blakemore, El Monte, $191,-806.50.

KERN COUNTY—Between Democrat Springs and Bodfish, about 15.5 miles to be widened, bituminous surface treatment applied and a reinforced concrete bridge across Clear Creek to be constructed. District VI, Route 57, Section H. Clyde W. Wood & Sons, Inc., North Hollywood, $372,736; McKinley & Kirk Construction Co., Paramount, $380,772; Basich Bros. Construction Corp., San Gabriel, $378,-825. Contract awarded to Dimmitt & Taylor and T. M. Page, Monrovia, $363,308.

KERN COUNTY—At Howling Gulch, 0.5 mile southwest of the town of Woody, about 0.1 mile of roadway to be graded, bituminous treatment applied, and a field-assembled metal plate pipe arch culvert to be installed. District VI, Route 142, Section C. Miles & Bailey, Madera, $6,271; Rexroth & Rexroth, Bakersfield, $7,305; Griffith Co., Los Angeles, $7,948; Thomas Construction Co., Fresno, $8,752; Phoenix Construction Co., Inc., Bakersfield, $8,882, Anderson Co., Visalia, $9,235; Richard J. Repsher & Sons, Bakersfield, $10,125; Dicco, Inc., Bakersfield, $10,792. Contract awarded to Rand Construction Co., Bakersfield, $6,193.50.

LOS ANGELES COUNTY—On Santa Ana Freeway, between Augusta Avenue and 0.1 mile easterly of the Rio Hondo, portions, about 2.3 miles to be graded and portions surfaced with portland cement concrete pavement on cement treated subgrade; interchange roadways, acceleration and deceleration lanes and outer highways to be surfaced, three grade separation structures and two pedestrian overcrossing structures to be constructed to provide a freeway with six lane divided roadway. District VII, Route 166, Section A. Guy F. Atkinson Co., Long Beach, $1,711,614; Griffith Co., Los Angeles, $1,715,290; Webb & White, Los Angeles, $1,795,797; Winston Bros. Co., Monrovia, $1,808,543; Cox Bros. Construction Co. and J. E. Haddock, Ltd., Pasadena, $1,972,182. Contract awarded to United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,645,114.50.

LOS ANGELES COUNTY—In Arroyo Seco Park, over Arroyo Seco Channel, near Avenue 58, a prestressed concrete girder pedestrian bridge to be constructed. District VII, Route 205. J. E. Haddock, Ltd., Pasadena, $24,810; McClain Construction Co., Inc., Hawthorne, $42,280; Concrete Construction Service, Inc., Gardena, $46,811. Contract awarded to Walter Kaucher, Los Angeles, $23,770.

MADERA COUNTY—At Ash Slough and Berenda Slough, about 9 miles and 3.5 miles west of Califa, existing bridges to be repaired and resurfaced, highway embankments to be constructed and surfaced with plant-mixed surfacing and a detour to be constructed. District VI, Route 32, Section A. Guy F. Atkinson Co., South San Francisco, $48,775. Contract awarded to Thomas Construction Co., Fresno, $39,306.50.

MONO COUNTY—Between 0.8 mile north of McGee Creek and 1.6 miles north of McGee Creek, about 0.8 mile to be graded and surfaced with road-mixed surfacing. District IX, Route 23, Section D. Downer & Eckley, Reno, $44,949; Ken Lowe, San Bernardino, $47,252; Harms Bros., Sacramento, $47,289. Contract awarded to Conrad Construction Co., Inc., Ojai, $43,067.45.

MONTEREY COUNTY—Across Willow Creek and Villa Creek, about 65 and 69 miles south of Monterey, existing bridges to be repaired. District V, Route 56, Sections B. A. Wm. Radtke & Son, Gilroy, $61,367; Chittenden & Chittenden and B. S. McElderry, Berkeley, $78,943; Dan Caputo, San Jose, $63,820; William S. Shedd, Yuba City, $72,-337. Contract awarded to E. G. Perham, Los Angeles, $58,243.50.

RIVERSIDE AND SAN BERNARDINO COUNTIES—On La Cadena Drive, at Russell Street, Down Street, Charles Street, Santa Ana Street-Columbia Avenue, Center Street, and at the north end intersection area, furnishing and installing highway lighting systems. District VIII, Route 43. Clinton Electric Corp., Los Angeles, $9,133; Fishbach & Moore of California, Inc., $10,537; Westates Electrical Construction Co., Los Angeles, $13,581. Contract awarded to H. C. Warren, Riverside, $7,450.

SAN BERNARDINO COUNTY—On Foothill Boulevard at Sierra Avenue and at Riverside Avenue, full traffic actuated signal systems with highway lighting to be furnished and installed at two intersections and channelization to be constructed. District VIII, Route 9, Sections B, Ria. Paul R. Gardner, Ontario, $32,951. Contract awarded to Westates Electrical Construction Co., Los Angeles, $32,464.

SAN DIEGO COUNTY—In the City of National City, at the intersection of Eighth Street with Harbor Drive, traffic signal system and highway lighting to be furnished and installed. District XI, Route 2. Ets-Hokin and Galvan, San Diego, $10,100; Westates Electrical Construction Co., Los Angeles, $9,983. Contract awarded to California Electric Works, San Diego, $9,827.

SAN DIEGO COUNTY—At the intersections of Grant Avenue with State Highway and Grand Avenue with Broadway, two traffic signal systems and one highway lighting system to be furnished and installed. District XI, Routes 77, 197, Section Esd, F, Esd. California Electric Works, San Diego, $14,264; Westates Electrical Construction Co., Los Angeles, $13,969. Contract awarded to Ets Hokin & Galvan, San Diego, $12,577.

SAN FRANCISCO COUNTY—In the City and County of San Francisco, at 129 Oak Street, State garage building to be painted. District IV. Dave Russ, San Francisco, $3,809; Russell Hinton Co., San Francisco, $3,898; Beck Brothers, San Francisco, $3,910; D. F. Burgess Co., San Francisco, $3,998; R. W. Reade and Co., Berkeley, $4,247; Abco Painting Co., San Francisco, $4,285; Gardner S. Wilson, San Francisco, $4,425; R. P. Paoli & Co., San Francisco, $5,573; Giampolini & Co., San Francisco, $5,588; Raphael Co., San Francisco, $7,622.

Contract awarded to H. L. Painter Co., Berkeley, $3,175.

SAN FRANCISCO COUNTY—In the City and County of San Francisco, furnish and install an automatic sprinkler system for fire protection of State Garage Building at 129 Oak Street. District IV. Barnard Engineer Co., of Northern California, San Francisco, $4,265; Automatic Sprinklers of Pacific, Inc., Los Angeles, $4,461; California Automatic Sprinkler Co., San Francisco, $4,610; Allan Automatic Sprinkler Service, San Francisco, $4,812. Contract awarded to Grinnell Co. of the Pacific, $3,900.

SAN JOAQUIN COUNTY—At branch of Mormon Slough and at Lone Oak Creek, existing bridges to be removed and culverts to be installed, roadbeds to be graded, and plant-mixed surfacing on untreated rock base to be placed. District X, Route 75, Section B. Paul E. Woof, Fresno, $31,908; Edward Keeble, San Jose, $31,980; Eugene G. Alves, Pittsburg, $32,162. Contract awarded to Thomas Construction Co., Fresno, $30,103.

SAN LUIS OBISPO COUNTY—Portions between Route 33 and Kern County Line, about 3.7 miles, cement treated imported base to be constructed, plant-mixed surfacing to be placed thereon and seal coat applied. District V, Route 125, Section D. Clyde W. Wood and Sons, Inc., North Hollywood, $131,666; Oldfields Trucking Co., and Phoenix Construction Co., Inc., Bakersfield, $137,693; Madonna Construction Co., San Luis Obispo, $142,168; Valley Paving and Construction Co., Inc., Pismo Beach, $159,124; R. P. Shea Construction Co., Indio, $159,897; E. S. and N. S. Johnson, Fullerton, $173,037. Contract awarded to Granite Construction Co., Watsonville, $126,348.40.

SAN MATEO COUNTY—At Alemany Boulevard and Skyline Boulevard and at Alemany Boulevard and Junipero Serra Boulevard, channelization to be constructed and full traffic actuated signal systems and highway lighting to be furnished and installed. District IV, Routes 55, 56, Sections A, E, DIC. J. Henry Harris, Berkeley, $101,245; Charles L. Harney, Inc., San Francisco, $108,354. Contract awarded to Eaton and Smith, San Francisco, $100,142.

SHASTA COUNTY—At Hatchet Creek line change, about 1.6 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District XI, Route 28, Section C. Harms Brothers, Sacramento, $368,257; Rand Construction Co., Inc., Bakersfield, $372,582; Fredrickson and Watson Construction Co., Oakland, $423,800; H. Earl Parker, Inc., Marysville, $430,274; Chittenden and Chittenden and B. S. McElderry, Auburn, $448,417; J. P. Brennan, Redding, $486,884; Fredrickson Brothers, Emeryville, $492,431; L. A. and R. S. Crow, El Monte, $594,256. Contract awarded to Eaton and Smith, San Francisco, $333,843.

SOLANO COUNTY—Across Cutoff Slough about 5.5 miles southeast of Suisun, a bridge consisting of a steelbeam span and timber trestle approach spans to be constructed. District X, State Waterfowl Refuge. Chittenden and Chittenden and B. S. McElderry, Auburn, $25,863; Ben C. Gerwick, Inc., San Francisco, $27,674; C. C. Gildersleeve, Nevada City, $28,978. Contract awarded to Al Erickson and Co., Napa, $23,928.

SONOMA COUNTY—Between Santa Rosa and Kenwood, portions, three bridges to be widened, culverts to be extended and approaches to be constructed. District IV, Route 51, Section A. Dan Caputo, San Jose, $85,781; Chittenden and Chittenden and B. S. McElderry, Auburn, $89,723; A. G. Raisch Co., San Rafael, $94,261; Eugene G. Alves, Pittsburg, $101,033. Contract awarded to R. G. Clifford and C. O. Bodenhamer, South San Francisco, $79,832.

SONOMA COUNTY—Between Jenner and the Mendocino County line at Gualala, portions, about 1 mile to be graded, imported base material to be placed, and surfaced with bituminous surface treatment. District IV, Route 56, Sections C, D, E. Parish Brothers, Benicia, $131,124; Eugene G. Alves, Pittsburg, $141,907; Arthur B. Siri, Inc., Santa Rosa, $149,108; J. Henry Harris, Berkeley, $152,649. Contract awarded to Huntington Brothers, San Anselmo, $120,138.80.

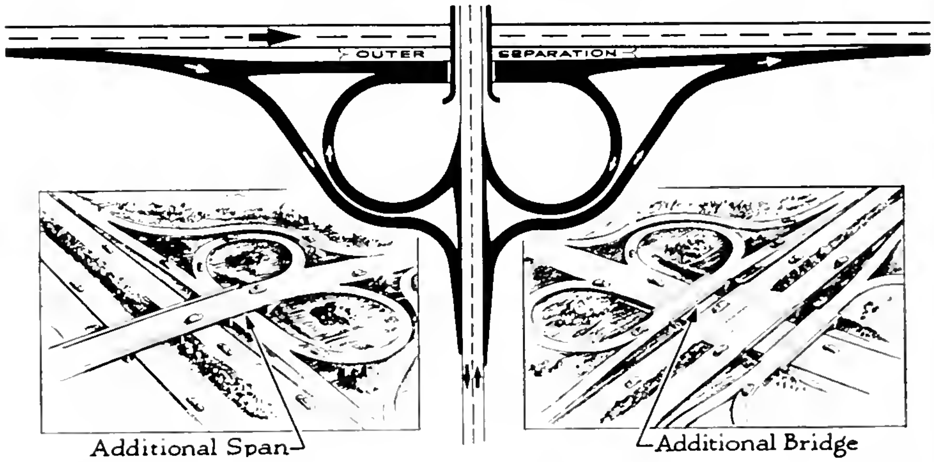
SONOMA COUNTY—Between Sears Point and Solano County line, about 2 miles, existing shoulders to be excavated, backfilled with imported base material and prime coat and seal coat applied. District IV, Route 208, Section A. Piombo Construction Co., San Francisco, $21,647; Brown Ely Co. and

Traffic Interchange Design

Continued from page 53 . . .

turning right to go left. This is an unnatural movement that may lead to confusion. The necessity of having two off-ramp and two on-ramp connections on the same side of the freeway adds

COLLECTOR ROAD



to the potential confusion and introduces signing difficulties.

"Collector or Mixing Road" Modification

A further deficiency of design is the overlapping of the acceleration and deceleration lanes of the inner loops which may impair the operating efficiency of the interchange during peak hours. This deficiency can be relieved by a modification of design, known as a "Collector or Mixing Road." A collector road is an additional parallel road physically separated from the through lanes. All leaving interchange traffic departs from the freeway and enters the collector road as it approaches the interchange point. Right and left turns from this collector road are then made on the basis of a conventional cloverleaf pattern, with left turns required to weave across traffic entering the collector road from the cloverleaf loop provided for freeway "on" traffic. The "on" traffic is consolidated on the collector road beyond the interchange structure and brought into the freeway at a single point of entry. Although the weaving movement between leaving and entering traffic has not been eliminated, it is accomplished on a separate roadway clear of the high-speed through traffic.

This type of design increases construction cost, due principally to increased structure requirements. If the freeway passes under the cross street, an additional span over the collector road and an additional pier in the neutral area between the freeway and collector road are required. If the freeway passes over the cross street, an additional separate structure is required for the collector road over the cross street.

This article to be continued in the next issue

E. A. Forde, Corte Madera, $23,457; J. Henry Harris, Berkeley, $24,750. Contract awarded to A. G. Raisch Co., San Rafael, $20,827.50.

STANISLAUS COUNTY—Near north city limits of Turlock, a highway lighting system to be furnished and installed; and at Keyes Road a traffic signal system and highway lighting to be furnished and installed. District X, Route 4, Section A. Howard Electric Co., Gilroy, $20,950; Clinton Electric Corp., Los Angeles, $22,242; Westates Electrical Construction Co., Los Angeles, $22,826; L. H. Leonardi Electric Construction Co., San Rafael, $24,164; R. O. Ferguson Co., Visalia, $24,918; Underground Electric Construction Co., Oakland, $25,989. Contract awarded to R. Goold & Son, Stockton, $19,912.

STANISLAUS COUNTY—At M. I. D. lateral No. 4, about one mile west of Modesto, about 0.3 mile to be graded, untreated rock base and plant-mixed surfacing to be placed; and an existing reinforced concrete bridge to be widened. District X, Route 110, Section B. Thomas Construction Co., Fresno, $29,102. Contract awarded to M. J. Ruddy & Son, Modesto, $24,419.95.

TULARE COUNTY—Between Tulare Airport and Tagus, about 7.8 miles to be graded, portions paved with Portland cement concrete pavement on cement treated subgrade; portions to be surfaced with plant mixed surfacing on untreated rock base or imported base material and two bridges to be constructed. District VI, Routes 4, 134, Sections B, Tul, F. B. Griffith Co., Los Angeles, $916,855; Fredrickson Bros., Emeryville, $956,680; Dan Caputo and Edward Keeble, San Jose, $966,703; N. M. Ball Sons, Berkeley, $986,446; Cox Bros. Construction Co. and J. E. Haddock, Ltd., Pasadena, $986,973; Guy F. Atkinson Co., South San Francisco, $991,304; Clyde W. Wood & Sons, Inc., North Hollywood, $1,005,660; Peter Kiewit Sons Co., Arcadia, $1,006,774; Webb & White, Los Angeles, $1,086,252; Basich Bros. Construction Co., San Gabriel, $1,147,919. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $895,579.50.

Stores Department

Turkey Sends Engineer to Study California Methods

By PHYLLIS MANTHE, Secretary, Stores Department

TURKEY, which has launched a $400,000,000 highway program, will pattern her supply system after California Highway Stores Department. Mr. Cemil Mutus has been selected by the Turkish Government to study the Highway Stores Department for a 10-months period under a grant from the Economic Corporation Administration and through the Federal Bureau of Public Roads.

CEMIL MUTUS

The California department is a new and unique venture in solving highway supply problems and, although organized only three years ago, has obtained considerable recognition at home and abroad.

Jimmy—the nickname given Mutus by American engineers with whom he worked in Turkey—is starting in the Stores Department as a junior clerk and will work his way up through each position to the top. In this way he will

T. C.
BAYINKIRLIK BAKANLIGI
KARAYOLLARI GENEL MUDURLUGU
Idari Isler, Dairesi Boskanligi
October 13, 1950

Mr. Milton Harris
California Division of Highways
Sacramento, California, U. S. A.

Dear Mr. Harris: Please accept our sincere thanks for the kind interest you have shown by helping Mr. Cemil Mutus of our organization, who is making studies on storage subjects in California. We are certain that the directorate will greatly benefit by your generous cooperation.

At the present we are making preparations to establish a new system of storage which will be based almost entirely on the system in use by the California Division of Highways. Thinking that it may interest you, therefore, we are planning by your approval, to establish correspondence with you on the relevant results we shall obtain and difficulties we may come to meet.

Thanking you again for your kind interest and assistance, I am

Yours very truly,
VECDI DIKER
Director of Highways

learn to handle the practical work of acquiring and moving supplies for his nation's construction program. This training, together with his Masters Degree in engineering will form the basis for his heading of Turkey's highway equipment depot at Iskenderun, which has a $10,000,000 stock.

Highway Network Planned

The new Turkish highway network will cover 14,000 miles and is expected to take nine years to complete.

"Here, for instance will be new road" says Jimmy in his soft slurring accent as his finger runs across the width of Turkey on a highway map.

"Antakya to Erzurum will be all new road," he says pointing to a stretch which the map symbols identify as graveled or dirt road.

"And here, and here will be all new highway" as he points to many green lines cross-patching the map of Turkey and signifying foot trails.

Milton Harris, head of the Highway Stores Department, is supervising Jimmy's "on the job" education. The California Division of Highway Stores Department, the only unified public road building supply operation in the Nation, was selected as Jimmy's school room after Turkish officials read an article entitled "Efficiency" about the agency in *California Highways and Public Works* issue of January-February, 1949.

Tour of Education

Mutus will not only work in the Stores Department Headquarters Office, but will work in both the Sacramento and Los Angeles Warehouses, and will also be an observer in other departments of the Division of Highways in order to learn the correlation between service and supply and the operation of the various agencies. He will also look in on the operations of private companies which manufacture road building materials and other commodities, as well as visit various road jobs under way.

Jimmy's new knowledge will be added to that of 22 other Turkish highway specialists studying road building techniques in other parts of the Nation.

Life in Sacramento, is of course, very different for Jimmy from life in Turkey. He has been in Sacramento about a month and seems to enjoy everything, particularly American living and American food.

He attended a college football game and although the game was interesting, he thought it was much slower than the soccer football played in Turkey.

He also is learning about family life, Sacramento style, living with the W. F. Combrink family at 3700 Brockway Court.

Looking southeasterly showing construction under way near the City of Anaheim

Progress Report

Continued from page 21 . . .

of unforeseen difficulties with numerous irrigation lines, which slowed down operations temporarily.

Third Project

The limits of the project are from Euclid Avenue to Route 2 (U. S. 101) near Miraflores on Manchester Boulevard, a distance of 2.88 miles. The work on the permanent part of the freeway, which is outside of the city boundaries of Anaheim, consisted of the constructing of a new highway paralleling the present Manchester Boulevard with a surface of asphaltic concrete pavement and a cement-treated base, thus providing a four-lane limited access divided freeway, with outer highways and other portions surfaced with plant-mix and an untreated crushed rock base. The new roadway will carry the northbound traffic, while the old pavement will carry the southbound traffic, outside the city limits of Anaheim.

This remaining portion of the freeway is in the southwestern section of the City of Anaheim, and at some future date will be by-passed by an overhead freeway cut-off, alleviating local traffic conditions. The construction work which is within the city limits consists of the widening of existing Manchester Boulevard pavement and building of traffic islands to control traffic which is supplemented with traffic-actuated controlled signals throughout the project. The installation of the signals was done under a separate contract.

Drainage Problem

The shoulders and portions of the outer highway are constructed of an untreated crushed rock base with a bituminous surface treatment.

The drainage structures constructed on this project consisted of box culverts with open topped flumes in the highway dividing strips, most of them having very flat gradients because of flat terrain. On two portions of the job it has been necessary to tie into the Orange County Flood Control storm sewer system.

The low, flat terrain adjacent to the highway throughout the length of these jobs has made it extremely difficult to obtain satisfactory drainage. All of the culverts are of necessity constructed to a very flat gradient and function in effect as equalizing structures.

Completion of these three contracts is expected sometime in January, 1951. These projects are of considerable significance when it is considered that they represent approximately 35 percent of the total mileage of the Santa Ana Freeway. Together they comprise by far the greatest step to date toward completion of this major freeway.

Construction is under the supervision of F. B. Cressy, Assistant District Engineer, Construction. The resident engineers are B. N. Frykland and C. E. Dresser. The Bridge Department representative is E. B. Brier. The writers of this article are the office engineers for the three contracts.

Piru Gorge

Continued from page 43 . . .

It is anticipated that this work will be completed well ahead of schedule.

The cooperative efforts of the contractor's forces have provided the traveling public with a maximum of safety and a minimum of delay and inconvenience.

The winter rains, snow and ice will present a different problem, but every effort will be made to keep traffic moving at all times.

Plans are being prepared for a similar improvement of the remaining five miles of three-lane highway in Weldon Canyon from Pico Canyon to San Fernando Road at Tunnel Station which will be placed under construction after the first of the year. Upon completion of this latter section, the divided highway will extend from the Los Angeles city limits to and through McFarland, north of Bakersfield.

In Memoriam

RALPH CATHER MYERS

On October 2, 1950, friends and associates of Ralph Cather Myers were saddened by news of his sudden passing.

Ralph was born in Bakersfield, California, on June 9, 1892, and upon his graduation from Stanford University in 1914, came to work for the California Highway Commission. His first association with highways was survey work in and around Fresno where he worked as rodman and instrument man on projects authorized by the first highway bond issue.

After an employment period of about two years, Ralph left state service to return again in 1917, and from then until 1918 he worked continuously in the positions of Chief of Party and Assistant Resident Engineer on construction jobs. In 1918, he left the employ of the State to enter into private practice which he pursued for the ensuing 10 years until his return to the Division of Highways in 1928 as an Assistant Resident Engineer. From then until his passing, he has been continuously employed by the Division of Highways in positions of increasing responsibility, and at the time of his death Ralph was an Assistant District Engineer in District VII.

He is survived by his widow, Winifred Myers, and his son, Chandler Myers, who is at present pursuing a pre-legal curriculum at Stanford University.

The heartfelt sympathy of the entire department is extended to his family.

In Memoriam

CYRIL P. PLUMMER

Friends and co-workers of Cyril Plummer were grieved to learn of his death in Pasadena on July 2, 1950. Cyril organized the District III traffic department and served as District Traffic Engineer most of the time until just a few months before his passing.

He was born in Pennsylvania April 2, 1891, and started his engineering career with a private engineer in Michigan in 1913. From then until 1928, with some time out for service in World War I, he worked as a surveyor and resident engineer for various employers in the Midwest and South.

In June of 1928 he came to work for District III as a draftsman. Soon progressing to Assistant Highway Engineer and later to Associate Highway Engineer, he served for over 10 years in the District Report Department preparing preliminary and final reports and specifications. In July of 1939 he was appointed District Traffic Engineer and he served in that capacity during the period when that department was developing from a minor function to its present position.

Cyril was well liked by all those who came in contact with him and had been active in state employees' work, having served as president of Peach Bowl Chapter No. 40, CSEA, some years ago.

Mr. Plummer is survived by his wife, Margaret H. Plummer, who also worked for District III for a period during World War II and at present is living in Loma Rica.

In Memoriam

MERLE H. GODWIN

Merle H. Godwin, Senior Bridge Engineer, died Saturday, October 28, 1950, in his home a few hours after being stricken with a fatal illness. His many friends in the Division of Highways mourn the loss of an exemplary man whose sincere friendliness and rich humor were the order of his life.

Merle, as he was known to everyone, was born in Napa on February 27, 1897, and there lived his youth and received his high school training. With the onset of World War I he enlisted and was one of the first to go overseas where he served with distinction in an aviation company.

Upon discharge he began his engineering career in the engineering office of his home county. Between college semesters he found short-term employment in private construction and in the Department of Public Works. His state service began in 1922 with an assignment in District I, and in 1924 he began his record with the Bridge Department. Aided by these assignments he graduated from the University of California in 1927 with a degree in civil engineering.

After graduation and a short sojourn in District V he returned to the Bridge Department where he was assigned to the newly-begun work of investigating the physical condition of all bridges in the State Highway System. Merle kept step with the growth and development of the department and developed a broad knowledge of the highway system and the endless variety of bridge maintenance problems. He was honored this year by being appointed chairman of a national committee on bridge maintenance of the Highway Research Board.

His engineering affiliations included membership in the American Society of Civil Engineers and the Structural Engineers Association of Central California. He was a member of the Del Rey Fraternity of the University of California and of Union Lodge No. 58 of Free and Accepted Masons.

Merle is survived by his widow, Frieda, and a sister, Doris Godwin.

Maintenance Men, Patrolmen Honored

Continued from page 55 . . .

Sacramento; Wells Cargo, Inc., Reno; Western Truck Lines, Los Angeles; also Bekins Van Lines, Inc., and Pacific Greyhound Lines.

The Donner Pass barbecue followed the same pattern as a similar affair given earlier this year by W. H. I. at Redding, Cal., to honor the maintenance men of Division II and the state highway patrolmen of U. S. Route 99.

In Memoriam

EDWARD N. (TED) WHITTEMORE

The many friends and co-workers of Ted Whittemore were shocked and saddened by his death on October 2, 1950, at his home, 935 North Magnolia Avenue, Whittier, California.

Ted was born June 2, 1896, in Denver, Colorado. In 1914 he graduated from Manual Arts High School in Los Angeles and was a graduate of the University of California at Davis, where he received degrees in civil engineering and agriculture.

In 1918 and 1919 he served with the United States Army in World War I. From 1919 until 1925 he was ranch manager and engineer with the Bastandury Ranch in La Habra. In 1925 and 1926 he engaged in private engineering work in Orange County.

From 1926 to 1927 Ted took his initial steps in public service as city engineer and street superintendent for the City of La Habra. From 1928 to 1933 he was a right of way agent for the Orange County Road Department, leaving there to join the Division of Highways of the State of California 17 years ago on October 2, 1933, where he served with distinction until his death.

He is survived by his widow, Eunice M. Whittemore, his daughter, Janet Whittemore Wood, and his son, Edward L. Whittemore.

Ted was instrumental in the development of the Division of Highways to its present status and was a charter member of the American Right of Way Association. He is deeply missed as a co-worker and even more as a friend.

His fellow workers and members of the American Right of Way Association join in extending their most profound sympathy to his family.

In Memoriam

WILLIAM O. VAN DEEVEN, JR.

The death of William O. Van Deeven, Jr., Assistant Highway Engineer in District III, on July 14, 1950, came as a sudden shock to his many friends and associates. Van died at the wheel of his state car while en route to the construction project in Sierra County on which he was Resident Engineer. Although he had been employed in District III only since March, 1947, his application to his work and his interest in working with and training younger employees already had won him many friends and an enviable reputation among his associates.

Born in Frankfurt, Germany, January 5, 1907, after coming to this country Van Deeven attended high school in Los Angeles and subsequently worked in various engineering capacities for several railroads and governmental agencies in California before entering the Army in 1942.

Starting as a private, Van rose rapidly through the ranks so that when he was discharged in 1946 he held the rank of major. During the early part of his service most of his time was spent in training engineering troops, after which he served with Army Engineering units in Okinawa and Korea.

In March of 1947 Mr. Van Deeven came to work with District III as an Assistant Highway Engineer and since that time he had handled assignments as Chief of Party and Resident Engineer in various parts of the District.

Survivors of Mr. Van Deeven include his wife and one small daughter who reside in Sacramento.

In Memoriam

HOWARD J. SHELLY

The sudden death on August 11, 1950, of Howard J. Shelly, a Junior Civil Engineer in District III, came as a severe shock to his many friends and acquaintances.

Joe was born in Minnesota on January 6, 1889, and received his schooling in that state until he went to work for a sawmill in Crookston in June of 1904. His first engineering experience came in 1907, when he went to work as a tapeman for the Great Northern Railway. From that time on, except for a few years in ranching and newspaper printing work and a short period in the Army during 1918, he was primarily a surveyor.

Most of his early engineering was done on railroads, one three-year period being with the Interstate Commerce Commission in connection with its valuation work on American railroads. His state service began in 1922, when he went to work for District IV in San Francisco. After a two-year break in service, during which he was with the Spring Valley Water Company, he returned to state work in 1926 with District X and was transferred to District III in 1927.

During his 23 years with District III, Joe spent most of his time as head chainman or instrument man on survey parties. Many of the supervisory employees in this and other districts will remember with approval the steadying influence which Joe Shelly had on the younger members of survey crews and the helpful attitude which he brought to all his assignments.

Survivors include his wife and two sons, Jerrold and James, all residing in the vicinity of Yuba City.

ENJOY YOURSELF

Enjoy the scenery, as you drive, but not at the risk of an accident. Driving on busy highways and mountain roads requires your full attention. When you want to look at the scenery, pull well off the roadway and stop.

BASIC SPEED LAW

California's basic speed law requires that speed must be governed by prevailing conditions, such as visibility, traffic volume, condition of the highway, and other factors.

CHILDREN AT PLAY

Expect the unexpected when you are driving near schools. Remember, children at play are impetuous and thoughtless. Keep alert and be prepared to stop quickly if a youngster runs into the street.

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director

HIGHWAY COMMISSION

C. H. PURCELL . . . . Chairman
HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego
R. C. KENNEDY, Secretary . . . . . Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
R. M. GILLIS . . . Deputy State Highway Engineer
CHAS. E. WAITE . . Assistant State Highway Engineer
EARL WITHYCOMBE . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
T. E. STANTON . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
E. T. TELFORD . . . . . . Engineer of Design
F. N. HVEEM . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
J. P. MURPHY . . . . Principal Highway Engineer
E. J. SALDINE . . . . Principal Highway Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

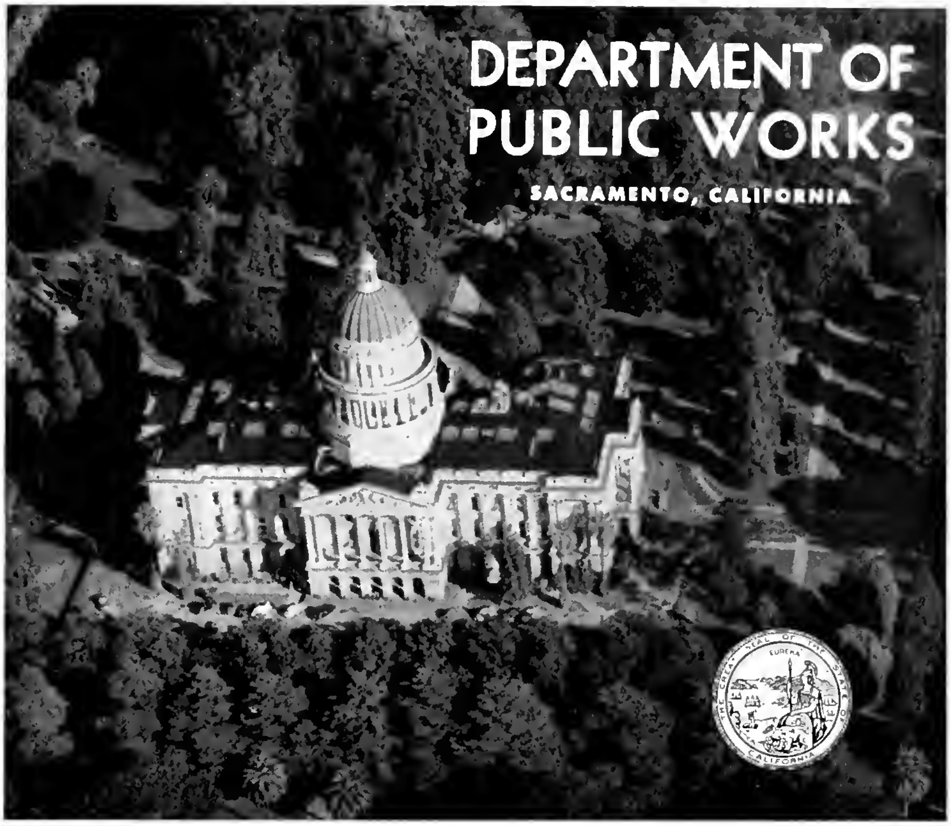
FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

District VII

P. O. HARDING . . Assistant State Highway Engineer



DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
S. W. LOWDEN . . . District VIII, San Bernardino
ALAN S. HART . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. R. SIMPSON
Principal Hydraulic Engineer, State-wide Water Plan
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
GEORGE B. GLEASON
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
H. S. HUNTER . . . . Deputy Chief
W. K. DANIELS . Assistant State Architect (Administrative)
P. T. POAGE Assistant State Architect (Design and Planning)
D. C. WILLETT . . . . Chief Construction Engineer

Headquarters

A. F. DUDMAN . . . Principal Architectural Designer
C. L. IVERSON . Supervising Architectural Draftsman
CARLETON PIERSON . Supervising Specification Writer
FRANK A. JOHNSON . . Principal Structural Engineer
C. A. HENDERLONG
Principal Mechanical and Electrical Engineer
WADE HALSTEAD . . . . . . Supervising Estimator

Schools

W. H. PETERSEN Principal Structural Engineer, Sacramento
H. W. BOLIN . Principal Structural Engineer, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 33468 7-50 26 400

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

Seattle Public Library,
Seattle,
Wash.

CALIFORNIA STATE HIGHWAY SYSTEM

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

JANUARY-FEBRUARY
1951

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

Vol. 30 January-February Nos. 1, 2

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

Fairfield Study

About 75 Percent of Businesses Bettered by Highway Realignment

By W. STANLEY YOUNG, Headquarters Right of Way Agent

Continuing our policy of publishing the results of economic studies of the effects of freeway construction on abutting and by-passed properties, we are presenting an analysis of the findings in Fairfield, Solano County, the third by-passed city to be studied and reported on by the California Division of Highways.

Fairfield was a growing community that had reached the stage of growth common to all progressive highway cities, where it was necessary to decide whether the business district was to move away from the through traffic or whether through traffic was to be removed from the business district.

Also, like many other highway cities, Fairfield was confronted with the question of whether or not the advantages to the community as a whole resulting from conjestion alleviation would offset the possible loss of sales to the motorist-catering businesses.

Fairfield Presented Problem

However, the problem in Fairfield was more serious than in many comparable cities, because it was a community enjoying a particularly strategic location, fifty miles east of San Francisco and 50 miles west of Sacramento on U. S. Highway 40, which carries at this point an average of 12,000 vehicles daily.

Because of this strategic location, cafes, bars and service stations, comprising 27 percent of the total number of retail businesses, were enjoying a very large highway patronage.

With full knowledge of the probable adverse nature of the immediate effects on this type of business, the Fairfield merchants, including cafe, bar and service station owners, apparently held no doubts concerning the long term benefits to business and property values.

Recognizing the growing gravity of the traffic situation and the ultimate strangling of all business growth by traffic congestion, they had exerted every effort to accomplish removal of through traffic.

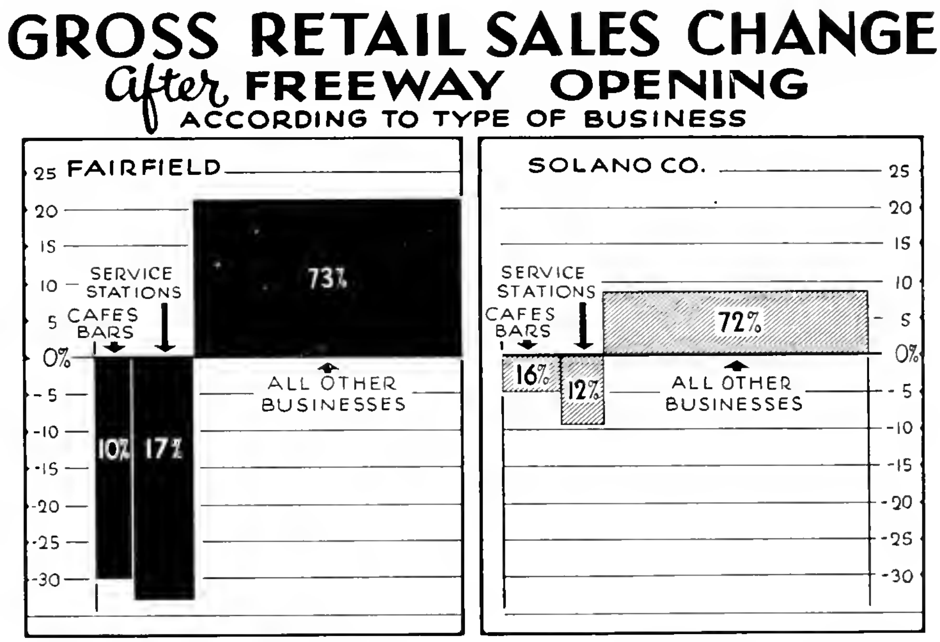
Judgment Sound

Now that the freeway construction has been completed and through traffic has been removed since July 2, 1949, the following facts prove the soundness of their judgment.

The cafes and bars, or 17 percent of the retail outlets, showed a 24.4 percent drop below the county average. The service stations, comprising 10 percent of the retail outlets, disclosed a 23.2 percent greater decrease than the county.

However, all other retail outlets, or the 51 stores catering to the general needs of the community and representing 73 percent of the retail outlets, showed an increase of 14.1 percent above the county average. In other words, 73 percent of the community definitely benefited financially by through traffic removal.

The accompanying graph illustrates the effects on each type of retail business by comparing the retail business volume change in Fairfield with Solano County during the year after the freeway opened. Also compared is the percentage of the total number of businesses contained in each class.



From this graph it is readily apparent that gains by the majority of the businesses more than offset the losses to the minority.

Effect on Service Stations

A further comment should be made at this point concerning service stations, which averaged a 23.2 percent net decrease. As in our studies of other locations, the service stations owned and operated by the petroleum companies were found to decrease considerably more than the locally operated outlets, and their over-all business volume and subsequent substantial decreases have weighed heavily in the average over-all service station business decrease attributable to the freeway.

In order to determine just what the net effects of the freeway by-pass were on the various business types, it was necessary for us to have some yardstick for measurement. Since our investigations indicated that populations and per capita income in Fairfield and in Solano County as a whole had increased at approximately the same rates and that other influencing factors had remained relatively constant

during the period, Solano County figures provided the accurate measuring device used in this study.

Some Facts

Principally from the following facts brought out in our Fairfield study we have been able to estimate the effects on retail business during the year after the by-pass opened in a city which was ideally located to siphon the maximum amount of business from travelers passing through the city.

Traffic reduction within the city, approximately 40 percent.

Parking meter use, 3.1 percent increase.

Population (3,607—1950 census), indicated increase approximately same as county rate.

Gross income, indicated increase approximately same as county rate.

Retail business	Total number of businesses	Fairfield volume	Solano County volume
All	70	4.5% increase	5.0% increase
Cafes and bars	12	30.0% decrease	5.6% decrease
Service stations	7	33.0% decrease	9.8% decrease
All other businesses	51	22.6% increase	8.5% increase

Comparison of average retail dollars per capita spent during year after freeway opening:

	Fairfield	Solano County
All businesses	$1,027.80	$691.87
Cafes and bars	112.97	83.40
Service stations	109.47	57.13
All others	805.36	551.34

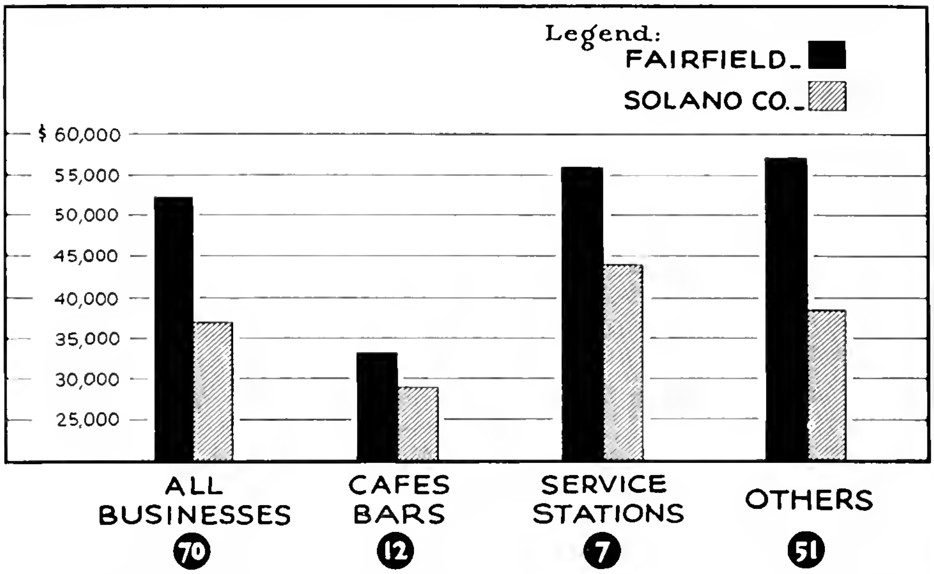
Situation Unusual

The situation of Fairfield was different than the typical highway city which is by-passed because of the unusually large percentage of the highway users having the same destinations, and because traffic and road conditions in the past had contributed to the forming of a habit on the part of these travelers of stopping in Fairfield for a bite to eat and automobile service.

That Fairfield's situation is unusual is further brought out by the fact that no modern motels had been built along the highway in the city, apparently because it was commonly known that most of the motorists were not traveling great distances and did not require overnight facilities.

Since the retail sales figures have disclosed that the class of businesses representing 73 percent of the total number in Fairfield enjoyed an average net increase of 14.1 percent, the question immediately arises as to the source of this increase—that is, whether the increase is attributable to increased local spending or new customers from rural districts and other communities formerly trading elsewhere. The subsequent analysis is an attempt to answer this question.

COMPARISON OF DOLLAR GROSS VOLUME PER RETAIL OUTLET DURING YEAR AFTER FREEWAY OPENING



Premise of Findings

Following in line with our assumption that Solano County figures are a satisfactory basis for comparison to determine the net freeway effects, it is also reasonable to accept the premise that the per capita business volume attributable to the residents of Fairfield should be about the same as the county average per capita figure. Therefore, the difference between the average per capita expenditure in Solano County and the average per capita expenditure in Fairfield during the year represents the amount of business in Fairfield which is attributable to purchasers living outside the city.

This premise holds true for the ordinary types of retail business which do not cater to, or enjoy only to a minor extent, trade from the highway traveler. However, it is obvious that such businesses as cafes, bars and service stations in Fairfield, where a very large percentage of their business came from highway travelers, cannot be measured in this manner. This is because such a large part of the highway traffic in the vicinity of Fairfield consists of people who are not Solano County residents.

Dollar Spending Increases

By eliminating these specific businesses from the over-all picture and considering only the other types of retail businesses we find that the dollars per capita spent in Fairfield during the one-year period after the freeway opening was 46 percent above that of the county. Please refer to the accompanying graph for a comparison of per capita business volume. Applying this percentage to the population of Fairfield, 1,659 people are indicated as being potential customers living outside the city.

By applying the 14.1 percent net increase in retail business volume of these pedestrian-catering types of businesses to the total number of potential customers, we find that the net increase in number of potential customers has been 743, as a direct result of the 40 percent reduction in city traffic.

These are regular customers of all businesses in the city or a year around basis, which will be lost only because of personal failures on the part of merchants to maintain competitive prices, service and quality merchandise.

Outside Customers Increase

The attributing of this increase primarily to new customers outside the city appears reasonable because Fairfield's business district is situated entirely along the superseded highway and is within walking distance of most of the residential section. Therefore, alleviation of congestion would not show an appreciable increase in the volume of purchases by the city dwellers.

The unusually heavy weight of cafe, bar and service station business in Fairfield in the over-all retail picture is evidenced by the fact that despite an average net benefit of 14.1 percent to 73 percent of the total number of businesses in Fairfield, the over-all volume of business in the city showed an increase approximately the same as the county.

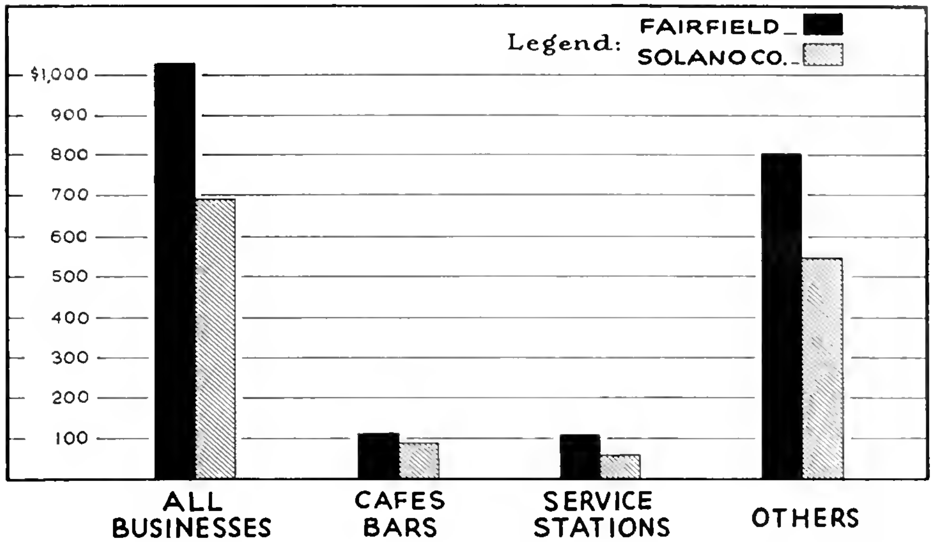
No Business Failures

Our study of business also disclosed that the 27 percent in number, consisting of cafes, bars and service stations, were formerly transacting approximately 33 percent of the total business volume. This ratio was not found to exist in either of our two previous studies of by-passed cities where the ratio of the number of these types of businesses to the total number of businesses was about the same as the ratio of business volume of these types to the total business volume. After the freeway opened, Fairfield businesses of these types were found to be transacting approximately 27 percent of the total city business.

The unusually high ratio of business, as well as the high ratio of per capita business volume to that of the county on the part of cafes, bars and service stations, may explain the reason why there have been no business failures in these types of businesses in Fairfield since the freeway opening despite the approximately one-third reduction in total volume. A casual observer, upon seeing an average decrease of 33 percent in any class of business on an average, would expect at least one failure as a result; inasmuch as this figure is an average and there must have been greater as well as some lesser losses.

A reference to the accompanying two graphs showing a comparison of per capita business volume and dollar gross volume per establishment to Solano County figures during the year after the freeway opened may be of considerable aid in picturing the excellent business conditions in Fairfield despite severe reductions in the particular business types previously mentioned.

COMPARISON OF PER-CAPITA BUSINESS VOLUME DURING YEAR AFTER FREEWAY OPENING.



Real Estate

The 66 real estate transactions which had taken place along the superseded route within the past three years indicate that the freeway had little or no effect on property values. Of the 66 properties which were sold during this period, 12 were vacant property sales which took place prior to the freeway opening and nine were vacant property sales which took place following its opening. A comparison of the average of these sales indicates a 13.8 percent increase in sales price after the freeway opened.

However, greater fluctuations in value were found between similarly located properties having similar highest and best uses than between the periods before and after the opening, so that the average increase in sales price should not necessarily be attributed to benefits of the through traffic removal. Nevertheless, all of these real estate transactions indicate that there has been no decrease in value of any properties along any section of the superseded route.

Present values along the sections outside the city limits are indicated to be approximately $800 to $1,000 per acre for road frontage. Highest and best uses of these properties remained identical, being either for residential subdivisions or commercial establishments catering primarily to local residents.

City Continues to Grow

It is interesting to note at this point that the lower valued business establishments catering to motorists outside the city did not generally disclose as great a decrease in business volume as did the downtown businesses of the same types. This is contrary to our findings in other by-passed cities where the downtown businesses have enjoyed greater benefits than the ribbon developments along the outskirts.

In the main business section, front foot values near the 100 percent locations presently range from $350 to $400 per front foot with no vacant property available for purchase. These values compare closely to the values found to exist in the cities of North Sacramento and Auburn, which have been previously reported, and whose businesses of all types disclosed benefits from through traffic removal.

Scene typical of the congestion in the heart of the Fairfield business district prior to the freeway construction. The benefits of the alleviation of this situation were made apparent by the increase in parking meter returns after the freeway by-pass opened

Like almost all other California cities, Fairfield is continuing to grow at a rapid rate with new businesses being established to take care of the expanding area population.

Excellent Background

The city has a well rounded background for economic stability. It is the county seat of Solano County in the center of a large agricultural area producing grain, fruits and livestock; a large Army Air Force base exists within a few miles and there are considerable recreational facilities, such as duck hunting and fishing close by.

There is little doubt that the construction of the freeway by-pass has removed a large obstacle in the way of Fairfield's transition from a small highway city to an economically sufficient unit.

Since completion of the freeway there is no longer the tendency for inexpensive ribbon commercial developments to spring up along the highway outside the city to provide more and more competition to the downtown merchants and to deteriorate the stability of downtown property values.

Conclusions

In arriving at our conclusions concerning the effects of the freeway by-pass on business and property values in the City of Fairfield, we must recognize that specific classes of businesses enumerated previously have suffered substantial reductions in volume of business transacted directly attributable to the removal of through traffic. This fact is tempered somewhat by the fact that the results during the first year after a city is by-passed are the most drastic to be expected and that, as the highway is completed to freeway standards along its entire length and as the habits of the travelers who, at least

temporarily, have ceased trading in the city are changed, the cafe, bar and service station business should improve along with other business types. Our studies in other locations have borne out this statement.

As for the effects of the freeway on approximately three-quarters of the business establishments in Fairfield, the statistics make it apparent that they have been greatly benefited by the removal of through traffic and the accompanying alleviation of traffic congestion.

There have been no readily apparent immediate effects on real estate values resulting from the freeway by-pass during the year following its opening. However, the inherent stability of real estate, supported almost entirely by local economy, tends to increase values because of this stability and the subsequent increased demand. With the passing of sufficient time this principle should be manifested in the properties along the superseded route in Fairfield.

In the event that the principles evolved from the Fairfield study are to be applied to another small highway city, which is also strategically located for the maximum realization of income from highway travelers, it will be necessary to decide whether the benefits to approximately 75 percent of the total number of retail businesses, and a considerably larger number of local residents, outweigh the detrimental, though not fatal, effects on the remaining 25 percent of the enterprises.

It should be borne in mind in making such a decision that the bonus value of a particular location along any section of conventional highway diminishes as each new competitive establishment is opened along the highway, and that, therefore, the extended projection of this bonus value into the future cannot be justified.

It should also be recognized that in any public improvement there is a varying percentage of the affected people to whom the improvement will be detrimental.

OUR TASK

To build a road
To bear the load
Between Point Here and There,
Barriers are crossed
At least time and cost;
TO ARRIVE is the builder's care.

S. R. OFFUTT,
Assistant Highway Engineer

Aerial view looking southerly over the city of Fairfield toward Suisun Bay in the background. The six-mile long superseded route is the road which makes a right angle turn near the upper left hand corner of the picture and passes along the main business street to a connection with the new freeway near the upper right hand corner in the direction of San Francisco. The length of the new section passing diagonally across the picture is 4.7 miles

Sign Legibility

Tests Show Lower Case Letters on Highway Signs Slightly More Readable

By KARL MOSKOWITZ, Traffic Department, and
GLEN MORGAN, Materials and Research Department

In order to settle a spirited controversy among technical experts regarding the legibility of lower case lettering on highway directional signs in comparison with that of capitals, the Division of Highways last summer made some controlled measurements of reading distances of both styles, using large numbers of observers.

The research was conducted as a joint project of the division and the Institute of Transportation and Traffic Engineering of the University of California, represented by Dr. T. W. Forbes, a national authority on sign legibility. Dr. Forbes presented a technical paper on the tests at the January (1951) meeting of the Highway Research Board, National Research Council.

IN 1949 the California Division of Highways began to use lower case letters for the large destination signs marking exit ramps on freeways in the Los Angeles area, as shown in *Photo 1*. The lower case alphabet distinguishes these signs from other directive, regulatory, and warning signs on the California Highway System, and their use so far has been reserved for marking points of exit from freeways, where traffic is dense and fast-moving, and the motorist has very little time to ponder what a sign says; in other words, where recognition must be instantaneous.

PHOTO 1 *Sign marking exit ramp on Hollywood Freeway*

The signs are mounted overhead because of their size and to make them visible from all lanes over the tops of preceding vehicles; they are illuminated because as landmarks they are even more necessary at night than in the daytime, and because it is not considered desirable to depend on reflected light which would have to be aimed so high in the air; and they are white-on-black because it has been found that the glare from black-on-white signs completely obliterates the message in many areas along the road.

PHOTO 2 *Advance "Get Ready" signs on Santa Ana Freeway*

Drivers Need Guidance

An overwhelming majority of the users of metropolitan freeways are habitual users. Driving a freeway differs from driving ordinary streets where buildings, commercial signs, traffic signals, and otherwise continuously varying landscapes keep drivers informed of the exact location at all times. They know what exit they are going to use, but due to the continuity of design and high speeds, they need precise guidance in order to make preliminary maneuvers and the actual exit smoothly. Reflectorized "get ready" signs are placed to face left and right lanes at headlight level, in advance of the exits *(Photo 2)*, and the large overhead sign marking the spot is visible practically from the moment the driver has passed the preliminary signs. Even the stranger knows what the wording is on the junction sign, because like the habitual user he has just seen the advance sign.

Divergent Views

In addition to the advantage of distinction for a distinctive use, it was held in some quarters that words in lower case letters could be read more easily than capital letters. This viewpoint had some scientific support, e.g., Chapanis, Garner, and Morgan state:

"We read material in capital letters much more slowly than material in lower case printing. Results of objective tests on this point agree with how readers feel about it. Most readers definitely do not like to read material printed entirely in capitals. The reason is probably that we destroy word form when we use capitals. If we take another look at the word 'destroy,' we will notice that the 'd,' 't,' and 'y' stand out because they are either above or below the body of the word. When we print DESTROY in capital letters, however, those cues are lost. All in all, therefore, a safe rule is that we should AVOID PRINTING IN CAPITALS." [1]

However, in other quarters it has been contended that the unused space between stems and between descenders of the lower case alphabet could be filled up by using larger letters of uniform height (i.e. capitals) and the very fact that the letters would then be larger would make the signs more legible.

Question of Uniformity

The further argument has been advanced that signs preferably should be uniform, even to having uniform lettering on signs having entirely different purposes. Uniformity of signs and devices, simply for the sake of uniformity, has become practically a fetish in the traffic engineering profession, but the original reasoning has gradually been lost sight of; there is no particular logic in insisting on uniformity between devices having opposite or dissimilar purposes. Rather, distinction, the exact opposite of uniformity, conceivably can be a greater virtue. The latter reasoning is used by the Committee on Uniform Traffic Control Devices in their designating diamond, square, and round shapes for signs with different meanings, and by all official sign authorities in California in utilizing red background for STOP signs.

In order to resolve these two points of view, experiments were conducted to determine the relative legibility of lower case and capital letters in large highway signs.

PHOTO 3 *Sign bridge during observation. Top, night. Bottom, daylight*

[1] *"Applied Experimental Psychology"* (p. 171), by A. Chapanis, W. R. Garner, and C. T. Morgan. New York, John Wiley & Sons (1949).

Procedure

At the time the experiments were being planned, it was not known (a) what sizes of each style would be equal in legibility, or (b) what dimensions of each style would produce equal-sized signs. It was surmised from previous work[2] that a relationship between letter size and reading distance could be established, and therefore observations were planned for three different sizes in each style, which would establish the size-distance relationship, following which comparisons could be made under various assumptions (equal legibility, equal height, equal width, equal sign length, or equal sign area).

A list of 24 California names was selected, and sufficient letters were made in three sizes of each style of alphabet to put them up on a sign bridge, six names at a time (see *Photos 3* and *5*).The capital letters were U. S. standard series E, with the stroke thickened to 0.20 of the height (standard stroke is 0.172 of the height). The lower case letters were as shown in *Photo 4*. In this alphabet the letter "o" is 5 wide to 6 high, the "b," "h," "k," "l," etc., are 17/12 the loop height, and the first letter of each word is a series D capital 1.5 the height of the loop. Stroke is approximately 0.22 of the loop height. All the letters were made by photographic enlargements so that each size was of identical proportions. To facilitate assembly, each letter was mounted on a piece of ⅛-inch masonite which included a variable "shoulder" on each side of the letter to compensate for vertical, diagonal, or shapes so that when letters were placed side by side the spacing appeared uniform. By using these shoulder widths, it matters not what combinations of letters are juxtaposed; the spacing will still "look right." The widths and spacing of each alphabet are shown in *Table 1*. The effectiveness of the mathematical spacing in producing an acceptable appearance can be judged from *Photo 3*. If it is desired to expand or contract the length of a word in order better to fit the sign length available, a constant amount (not a pro rata of the spacings tabulated) should be added between each letter. Readers are warned, however, that if the spacing is decreased appreciably, the letters will begin to merge and the legibility will be greatly reduced.

PHOTO 4 *The lower-case alphabet used in tests*

Groups of Observers

In addition to the 24 names, 24 six-letter "scrambled" words were invented in which all letters except Q and X were used an equal number of times.

The 48 words were divided into two schedules, one for day and one for night. The observers were divided into two groups. Each group saw half of the words in lower case and half in capitals, but group "B" saw the lower case counterparts of the words which group "A" saw in capitals, and vice

PHOTO 5 *Assembling and placing test signs*

[2] "*Legibility Distances of Highway Destination Signs in Relation to Letter Height, Letter Width, and Reflectorization*," by T. W. Forbes and Robert S. Holmes. *Proceedings*, Highway Research Board, Vol. 19 (1939).

TABLE 1

Letter Widths and Spacing as a Proportion of Height

CAPITAL LETTERS Inches per inch of letter height					LOWERCASE Inches per inch of loop height				
	Left shoulder	Neat letter	Right shoulder	Total		Left shoulder	Neat letter	Right shoulder	Total
A	0.11	1.02	0.12	1.25	a	0.15	0.85	0.25	1.25
B	0.22	0.81	0.15	1.18	b	0.26	0.86	0.14	1.26
C	0.12	0.80	0.14	1.06	c	0.15	0.85	0.16	1.16
D	0.22	0.81	0.13	1.16	d	0.15	0.84	0.25	1.24
E	0.22	0.77	0.14	1.13	e	0.15	0.85	0.16	1.16
F	0.22	0.74	0.10	1.06	f	0.13	0.55	0.14	0.82
G	0.12	0.80	0.14	1.06	g	0.15	0.85	0.25	1.25
H	0.22	0.82	0.23	1.27	h	0.26	0.84	0.25	1.35
I	0.22	0.20	0.23	0.65	i	0.26	0.25	0.25	0.76
J	0.08	0.77	0.23	1.08	j	0.04	0.47	0.25	0.76
K	0.22	0.84	0.09	1.15	k	0.26	0.83	0.14	1.23
L	0.22	0.77	0.09	1.08	l	0.26	0.25	0.25	0.76
M	0.22	1.04	0.23	1.49	m	0.26	1.42	0.25	1.93
N	0.22	0.84	0.23	1.29	n	0.26	0.85	0.25	1.36
O	0.12	0.84	0.13	1.09	o	0.15	0.88	0.14	1.17
P	0.22	0.82	0.13	1.17	p	0.26	0.84	0.14	1.24
Q	0.12	0.84	0.13	1.09	q	0.15	0.86	0.25	1.26
R	0.22	0.82	0.13	1.17	r	0.26	0.65	0.11	1.02
S	0.12	0.82	0.11	1.05	s	0.12	0.83	0.14	1.09
T	0.09	0.75	0.10	0.94	t	0.12	0.67	0.15	0.94
U	0.22	0.83	0.23	1.28	u	0.26	0.85	0.25	1.36
V	0.11	0.92	0.12	1.15	v	0.12	1.01	0.11	1.24
W	0.11	1.08	0.12	1.31	w	0.13	1.32	0.12	1.57
X	0.11	1.01	0.12	1.24	x	0.14	1.03	0.13	1.30
Y	0.10	1.01	0.11	1.22	y	0.14	1.07	0.11	1.32
Z	0.20	0.82	0.21	1.23	z	0.16	0.87	0.15	1.18
Average width, weighted according to frequency of occurrence				1.13					1.15

versa. The positions on the board of each size and style were systematically distributed, in order to eliminate any bias due to position or association of words. This is illustrated in *Figures 1* and *2*, which also show what words were used.

Legibility Distances

It was desired to determine the legibility distances of place names; however, it was known in advance of the observations that the distance at which the shape of a word is recognized depends not only on what word it is, but upon how familiar the observer is with that particular word. To each group of observers, therefore, 12 names were presented, which included two each of three sizes and two alphabet styles (2 x 3 x 2 = 12). Prior to seeing these words the observers were told only that they were California place names. This set of observations was called "without knowledge." Then the same words were presented again, in the opposite alphabet, and as was expected, all the words were seen farther. This set was called "with knowledge." Finally, the alphabet (less Q and X) was presented in scrambled six-letter combinations, in both capitals and lower case. On the following day, the other set of observers followed the identical schedule but in the opposite alphabet throughout.

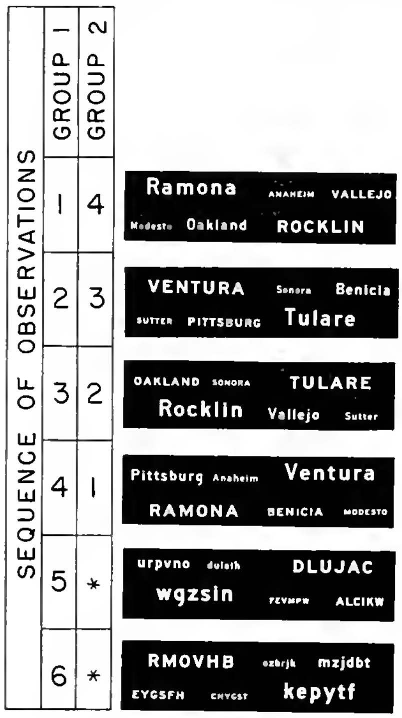
Types of Observation

Although the "with knowledge" names were more realistically related to actual sign reading than either of the others, it was thought that the "without knowledge" might correspond perhaps to the reactions of strangers who missed the advance signs, did not consult a map, and had no previous idea of where they were going anyway. The "scrambled" observations were made for control. In this type of observation, recognition is governed by letter patterns instead of word patterns, and the weakest letter in the six-letter group controls the distance at which the "word" is seen. (In scoring these observations, however, the distance of a given word was admitted to the results if one letter was wrongly seen.) The distances for scrambled "words" therefore generally represent the least legible one-sixth of the letters, and are far less than those for real words, which could be recognized by their larger over-all shape and in which observers were able to guess the weak letters.

Daylight Observations

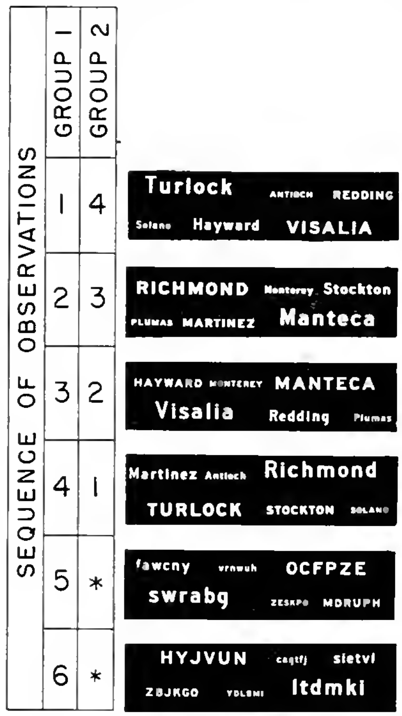
Daylight observations were made between 1.30 and 4.30 p.m. on a sunny day in July, with the observers facing east. For the night observations fluorescent tube (slimline) lights encased in showcase fixtures were mounted top

Fig. 1. Schedule of words observed, daylight—1 and 2, without knowledge; 3 and 4, with knowledge



* Group 2 observed other half of alphabets

Fig. 2. Schedule of words observed, night—1 and 2, without knowledge; 3 and 4, with knowledge



* Group 2 observed other half of alphabets

and bottom at a distance of three feet from the signboard, and were darkened by partial masking with friction tape so that the intensity of illumination on the letters was between 12 and 18 foot lamberts. It was found that higher illumination caused halation which reduced visibility.

Each group consisted of from 25 to 29 observers (*Photo 6*). Each size, style, and degree of knowledge was represented by two words for each group of observers, or four words for both groups, so that the mean or median distance for a given size, style, light condition, and degree of knowledge represented 110 to 112 individual observations.

PHOTO 6—Observers recording reading distances (1,200-foot marker in foreground)

The observers walked toward each setup of six words, recording what they saw and the distance at which they saw it, as illustrated in *Photo 7*, starting from 2,000 feet away. Due to the varying sizes on each setup it was very seldom that two words were seen at equal distances, and due to the slight difference in sizes of the capitals and lower case, observers were unaware of which they were "supposed" to see first, and unable to reflect any conscious or unconscious prejudice for either kind of letter. However, observations made by representatives of the Traffic Department of the Division of Highways and by others professionally interested in signs were disregarded in the analysis.

The observers were male and female, ranging in occupation from junior clerks to principal engineers and in age from 18 to 70. Their vision was tested by reading a Snellen eye test chart at 20 feet in a brightly-lit office with both eyes open and wearing glasses if they had them. Under these conditions, vision varied from line 7 to line 11 on the chart, with line 9.2 being the average and line 10 being the median. Line 8, with one eye, is considered to be "20/20" vision, so it is concluded that the vision of the observers was somewhat better than "average." However, on the full-size signs, it was found that the observers who had a Snellen rating of 8, recorded exactly the same average distances for "scrambled" letters as did the whole group.

Results

An average California name having seven letters and a horizontal length of eight feet can be read by the average office employee at the following distances:

	Lower case (11.9-in. loops)	Capitals (12.1-in. high)
By daylight	1,560 feet	1,380 feet
By night illumination	1,130 feet	1,050 feet

The choice of a parameter for purposes of comparing different alphabets can be argued interminably. Previous studies (2) have used letter height, because the height of all the capital letters of a given nominal size is nearly constant (letters with round tops and bottoms are about 3 percent higher than the others). These studies have established height-distance relationships for a constant height-width ratio, obtaining a different relationship for each different letter proportion. A rule-of-thumb which has been in use for many years is "50 feet per inch of height." * This is for a series D letter, but the value for a series E was greater and for a series C was less. For comparing the efficiency of alphabets having different proportions, therefore, letter height cannot be used, since the tall thin letters appear at a disadvantage compared with more "square" letters. Another way of stating the problem is: that height is a satisfactory parameter for comparing different sizes of the same series, or proportions, but it is unsatisfactory for comparing different proportions with each other. The same difficulty arises in attempting to compare lower case with capitals, but is even further complicated by the fact that one font of lower case contains letters of several different heights.

Two Approaches Used

To resolve this problem, two approaches may be used: (1) it may be assumed that physical controls exist at the site of the sign, and that this

* For estimating distance at which road signs are read by the average person, 100 feet per inch would be closer, according to the results of the present investigation. The previous tests determined distances at which observers detected misspellings of place names, instead of distances at which they recognized the words.

PHOTO 7—Sign bridge from 400-foot marker

control is the maximum length of sign for which there is room. In cantilevered signs, the length is also the most important consideration in computing wind and gravity stresses, and costs resulting therefrom; or (2) it may be assumed that the cost of the sign varies with the number of square feet of enamel, and that the most efficient sign is that which uses the least area for a given legibility distance.

For the purpose of sign design, it may be desirable to know the legibility distance of a given alphabet in terms of neat letter height, or loop height of lower case; in terms of gross height (guide line to guide line), depending on various assumption of line spacing; or in terms of sign length (center-to-center width of letters, including spacing, multiplied by the number of letters).

The results of our observations of lower case letters are shown in *Figures 3 (daylight) and 5 (night)*. Those for series E capitals are shown in *Figures 4 (daylight) and 6 (night)*.* These graphs are superimposed in *Figure 7* for comparison of lower case with capitals on the basis of sign length (approach No. 1, above). They are superimposed on the basis of sign area with different allowances for margins in *Figure 8*.

Lower Case Letters Favored

It will be seen that the differences are slightly in favor of the lower case letters unless very narrow horizontal margins are used on the capital letters, in which case capitals require less total area. These differences either way are not enough to be economically significant. However, the observations definitely prove that capital letter words are not significantly more legible on any basis, but on the contrary are slightly less eligible by most criteria.

It must be borne in mind that measurements were not made of time involved in reading either style; the glance legibility was not determined, either in terms of distance or glance time. This is an extremely important factor in freeway signs where split seconds of eyes-off-the-road are very important. The reason for not making these tests is simply that we did not

. . . Continued on page 61

* Straight lines were fitted to the 3,939 individual observations by the method of least squares, using zero distance for zero height as one of the points on each line. Lines connecting group averages varied, as can be seen on the graphs, both upward and downward from straight, and both above and below zero at the zero abscissa.

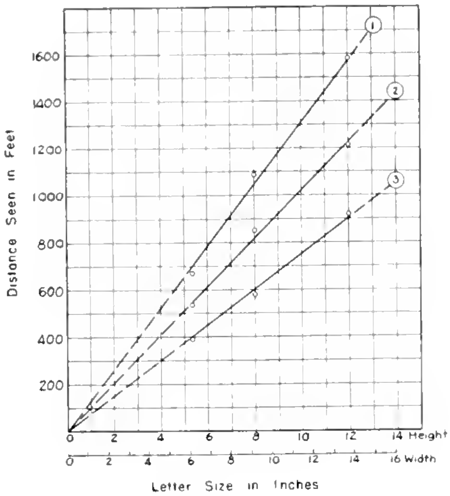


Fig. 3. Lower case, daylight. Average reading distance vs. letter size. (1) with knowledge; (2) without knowledge; (3) least legible single letters of six-letter groups

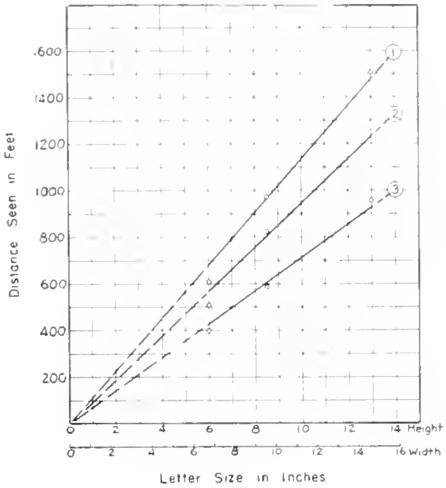


Fig. 4. Capitals, daylight

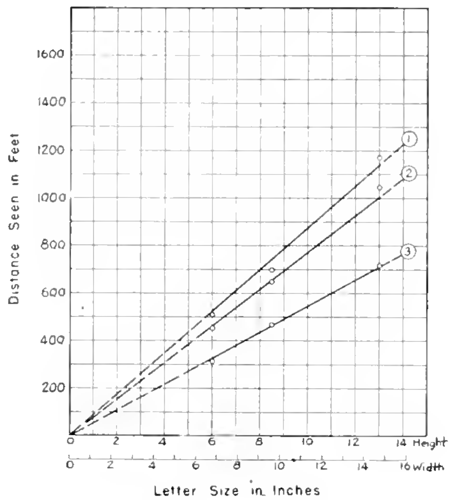


Fig. 5. Lower case, night

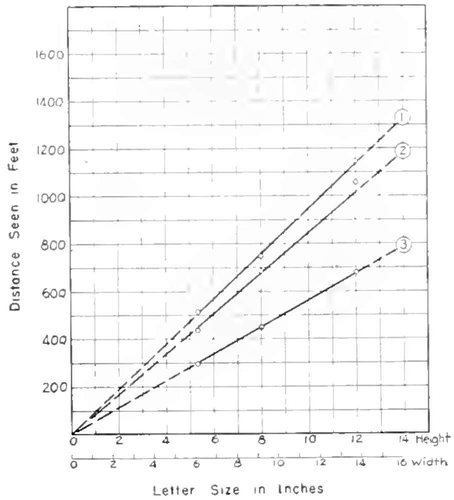


Fig. 6. Capitals, night

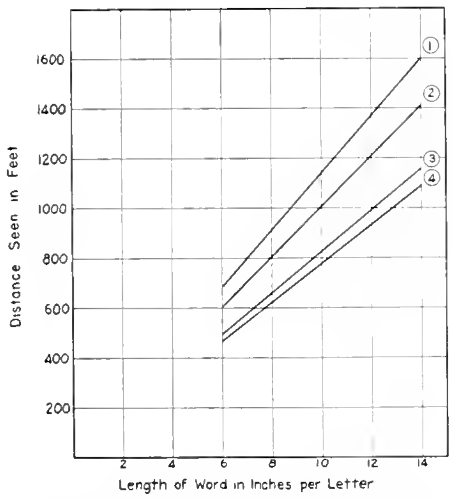


Fig. 7. Capitals vs. lower case, equal sign length, familiar place names. (1) lower case, daylight, (2) capitals, daylight, (3) lower case, night, (4) capitals, night

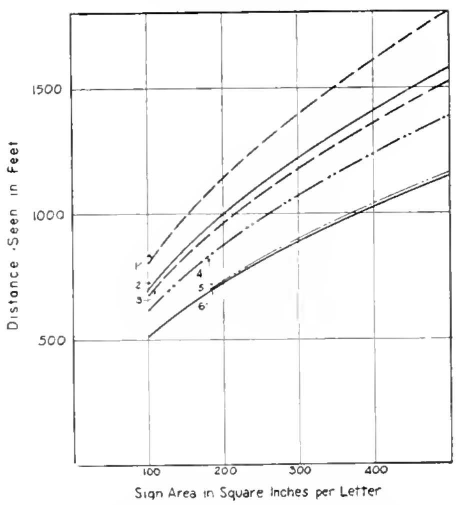


Fig. 8. Capitals vs. lower case, equal areas. (1) Capitals, daylight, 2 letter-heights per line. (2) Lower case, daylight, 3 loop-heights per line. (3) Capitals, daylight, 2½ letter-heights per line. (4) Capitals, night, 2 letter-heights per line. (5) Capitals, night, 2½ letter-heights per line. (6) Lower case, night, 3 loop-heights per line. (See Photo 8)

Hollywood Freeway

Third Unit of Construction Between Grand Avenue and Silver Lake Boulevard Dedicated and Opened to Public Traffic

By HARRISON R. BAKER, California Highway Commissioner

CULMINATING a long period of planning, preparation and construction, the first unit of the important Hollywood Freeway was thrown open to traffic following dedicatory ceremonies on Wednesday morning, December 27, 1950.

This first unit comprised the 2½ mile section of the Hollywood Freeway, extending from Grand Avenue to Silver Lake Boulevard, and represented a cost in excess of $12,000,000. The over-all financing allocated to the Hollywood Freeway project, of which this section is a part, has been approximately $44,850,000.

The dedication ceremony was held under the auspices of the Los Angeles Chamber of Commerce and was attended by officials of the State of California, the California Highway Commission, members of the staff of the Division of Highways, officials of the City of Los Angeles, the County of Los Angeles, and many civic organizations which have been instrumental in furthering the freeway program of the State Highway System.

Praise for Petree

Presiding at the ceremony was A. J. Gock, President of the Los Angeles Chamber of Commerce. Neil Petree, former Chairman of the Metropolitan Traffic and Transit Committee of the chamber, who for more than a decade has been an indefatigable worker for freeways. He was praised by all the speakers for his outstanding efforts which are bearing fruit as evidenced by the steady progress being made in the development of the Los Angeles metropolitan freeway system.

Lieutenant Governor Goodwin J. Knight represented Governor Earl Warren. He expressed the hope that the Hollywood Freeway and other freeways will reduce traffic accidents.

Highway Commissioner Harrison R. Baker speaking at ceremonies dedicating Hollywood Freeway

"I am grateful that I have the opportunity to dedicate this section of the Hollywood Freeway to the people of Los Angeles," said Director of Public Works C. H. Purcell, who is chairman of the California Highway Commission. "It is a tribute to those who gave their time and efforts to make it a reality. The remainder of the freeway connecting downtown Los Angeles with the San Fernando Valley should be completed by 1953."

It was my pleasure as a member of the Highway Commission to point out that already $44,500,000 has been expended on the freeway and many more millions will be spent. The commission expects to spend $17,500,000 during the next year.

"Here, at last," said Mayor Fletcher Bowron, "we find our dreams come true. This project is the result of cooperation between state and city governmental agencies. It is the beginning of a great freeway system."

Other speakers were Highway Commissioner James A. Guthrie of San Bernardino and Charles T. Leigh, San Diego; State Highway Engineer George T. McCoy, Senator Randolph Collier, co-author of the Collier-Burns Act and Chairman of the Senate Interim Committee on Highways, Streets and Bridges; Harold Henry, President of the Los Angeles City Council; Roger Jessup, Chairman of the Los Angeles Board of Supervisors; Sheriff Eugene Biscailuz and Spencer V. Cortelyou, retired assistant State Highway Engineer who launched construction of the freeway.

After the speech making, some 200 officials and other participants in the dedication ceremony entered autos and led by a car driven by Felix Chappelet, Chairman of the Chamber of Commerce Freeway Subcommittee, and containing Lieutenant Governor Knight, Mayor Bowron and Gock, drove through a crepe barrier and made a round trip from Grand Avenue to Silver Lake Boulevard. Hundreds of motorists followed them.

A $13,000,000 section of Hollywood Freeway was open to traffic.

Backbone of Freeway System

For the past 10 years the District VII organization of the State Division of Highways has considered the Hollywood Freeway as its number one freeway project. The Hollywood Freeway is what might be called the "backbone"

of the Metropolitan Los Angeles Freeway System. It is 10 miles in length, extending from Spring Street in the Los Angeles Civic Center area northwesterly to Vineland Avenue in the San Fernando Valley. The first unit of completed construction, 1½ miles in length, extending from Highland Avenue to Barham Boulevard in the Cahuenga Pass area, was opened to traffic the first of the year 1940. This was a Los Angeles City contract financed cooperatively with city, federal and state highway funds. Further construction on this important freeway was delayed until additional state highway funds could be provided as was done under the Collier-Burns Highway Act of 1947. With the additional financing thus made available, it was possible to proceed with the acquisition of rights of way and construction on the Hollywood Freeway.

Seventeen Contracts

The second unit to be completed was opened to traffic outbound in November, 1948, and inbound in January, 1949. This contract was two miles in length, extending from Barham Boulevard in Cahuenga Pass to Vineland Avenue in the San Fernando Valley, and was completed at a cost of $2,105,000.

The third unit of construction on the Hollywood Freeway just recently completed and opened to traffic, extending 2½ miles from Grand Avenue to Silver Lake Boulevard, cost a total of $12,000,000, and required the carrying out of 17 construction contracts.

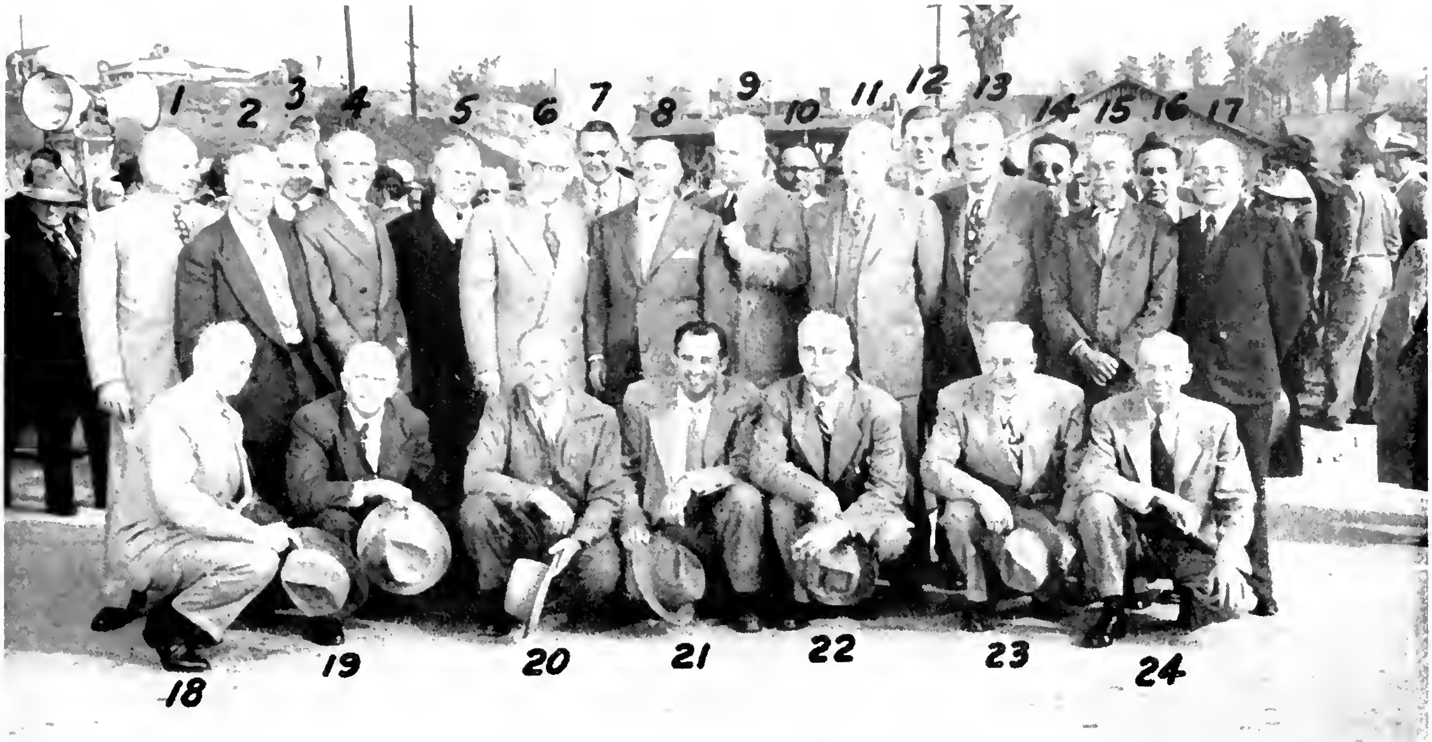
Four-level Structure

The necessity for having so many separate contracts was to carry out the work in the most economical and expeditious manner. In general, the procedure has been to advertise and let the construction contracts for bridge structures at grade separations first, and then to follow up later with grading and paving contracts.

Mention should be made that in this third section that is now open and being used by public traffic is the unique 4-level grade separation structure at the junction point of the Hollywood Freeway with the Harbor Freeway and the Arroyo Seco Freeway. This arrangement for handling grade separation and interchange traffic provides four separate roadway levels that pass or cross one another in a single bridge structure. The result is economy of construction cost and greater facility in the handling of traffic flow through the interchange. As of the present time, only the highest level of the 4-level grade separation structure is in use. Other levels of this bridge will be utilized later on as future

Official cars leading traffic over newly completed Hollywood Freeway following dedicatory ceremonies

Looking westerly over Alvarado Street interchange structure. In center is Rosemont Avenue bridge crossing with Benton Way bridge crossing in extreme background

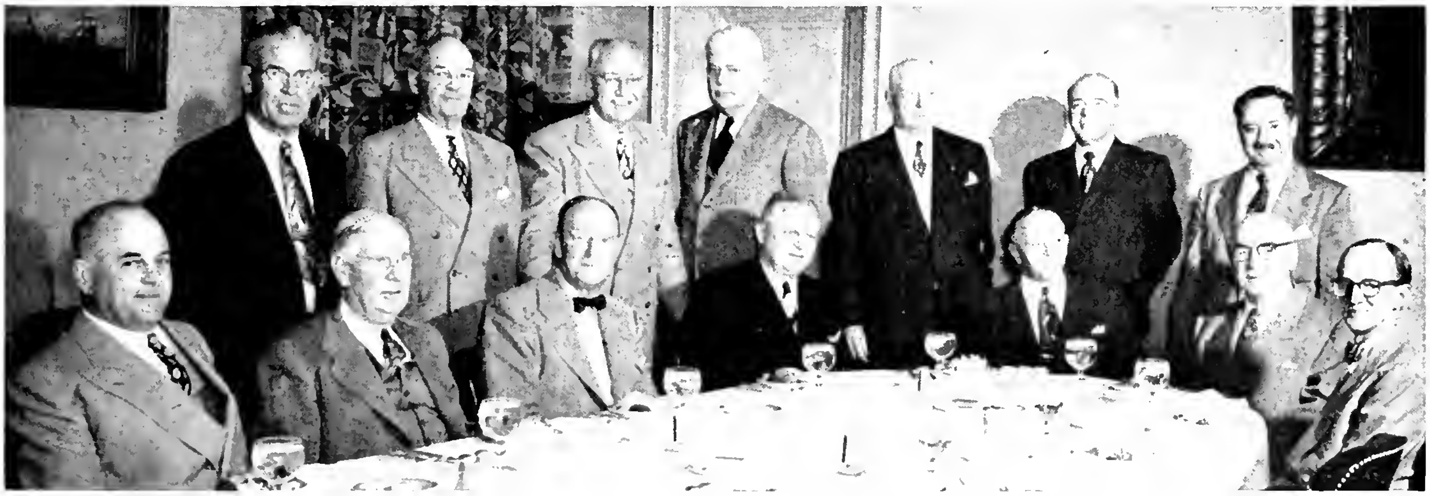


In this group are the men who conceived and constructed the new Hollywood Freeway. BY NUMBERS THEY ARE: 1. Frank C. Balfour, Chief Right of Way Agent; 2. W. L. Fahey, District Highway Engineer, Los Angeles; 3. J. W. Green, Supervising Bridge Engineer; 4. S. V. Cortelyou, Assistant State Highway Engineer, retired; 5. Harrison R. Baker, Highway Commissioner; 6. C. H. Purcell, Director of Public Works; 7. G. Langsner, Supervising Highway Engineer; 8. Harold A. Henry, President Los Angeles City Council; 9. F. W. Panhorst, Assistant State Highway Engineer (Bridges); 10. F. B. Cressy, Supervising Highway Engineer; 11. Jas. A. Guthrie, Highway Commissioner; 12. G. T. McCoy, Jr., Senior Highway Engineer; 13. G. T. McCoy, State Highway Engineer; 14. E. G. Bower, Senior Highway Engineer; 15. L. H. Gibson, District Highway Engineer, retired, San Luis Obispo; 16. J. W. Greeley, Associate Highway Engineer; 17. E. F. Wagner, Deputy Chief Right of Way Agent; 18. R. C. "Cass" Kennedy, Secretary of the Highway Commission; 19. Earl A. Parker, Senior Highway Engineer; 20. Herb Belford, Associate Highway Engineer; 21. Haig Ayanian, Senior Highway Engineer; 22. Alex Black, Assistant Highway Engineer; 23. P. O. Harding, Assistant State Highway Engineer in charge of Los Angeles office; 24. E. B. Curry, Senior Highway Engineer

connecting construction with Arroyo Seco and Harbor Freeways is carried out. On page 16 the 17 contracts are listed.

Unusual Economies

The last two contracts to be completed on this section of the Hollywood Freeway that is now open to public traffic were the two contracts with the N. M. Ball Sons Company. The first of these contracts extended from Grand Avenue to Glendale Boulevard



Following the dedication of the Hollywood Freeway, engineers of the Division of Highways and members of the California Highway Commission were tendered a luncheon by the Los Angeles Department of Airports. STANDING (left to right): W. L. Fahey, District Engineer, Los Angeles; R. C. Kennedy, Secretary, Highway Commission; Paul Harding, Assistant State Highway Engineer; F. W. Panhorst, Assistant State Highway Engineer; Joe Hartley, Commissioner of Airports; E. F. Wagner, Deputy Chief of Right of Way; Woodruff De Silva, Department of Airports. SEATED (left to right): Frank C. Balfour, Chief Right of Way Agent; Highway Commissioners James A. Guthrie, San Bernardino; Chas. T. Leigh, San Diego; Harrison R. Baker, Pasadena; Admiral Reeves, Department of Airports; C. H. Purcell, Director of Public Works; Airport Commissioner Ray Smith

Type of Construction	Contract	Resident Engineer
Grand Avenue Overcrossing	Oberg Brothers	W. V. Cryderman
Storm Drain	Chas. T. Brown Co.	B. N. Frykland
Four-level Grade Separation Structure	Jas. I. Barnes Construction Co.	H. R. Lendecke
Figueroa Street Undercrossing	Carlo Bongiovanni	J. M. Curran
East Edgeware Road Overcrossing	J. E. Haddock, Pasadena	E. B. Brier
Glendale Boulevard Overcrossing	J. E. Haddock, Pasadena	Jack Sylvester
Benton Way Overcrossing	Byerts & Dunn, Los Angeles	Jack Sylvester
Bonnie Brae Overcrossing and Beaudry Avenue Undercrossing	J. E. Haddock, Pasadena	E. B. Brier
Alvarado Street Undercrossing	Guy F. Atkinson Co., Long Beach	W. B. James
Rosemont Avenue Overcrossing	Spence Webb Co., Inglewood	A. K. Gilbert
Vendome Street Undercrossing and Coronado Street Undercrossing	Chas. McCloskey Co., San Francisco	W. H. Johnson
Silver Lake Boulevard Undercrossing	Guy F. Atkinson Co., Long Beach	W. H. Johnson
Boston Street and Edgeware Road Grade and Pave	McClain Construction Co., Hawthorne	B. N. Frykland
Boston Street Extension Grade and Pave	Dragline Rentals Co., Wilmington	B. N. Frykland
Virgil Avenue to Glendale Boulevard Grade and Pave	N. M. Ball Sons, Alhambra	H. E. Belford
Glendale Boulevard to Grand Avenue Grade and Pave	N. M. Ball Sons, Alhambra	Haig Ayanian
Virgil Avenue to Grand Avenue Lighting and Signs	Newberry Electric Corp., Los Angeles	R. E. DeGroff

and the second extended from Glendale Boulevard to Virgil Avenue. The fact that this company was the low bidder on two adjoining contracts of a similar nature made possible the working out of unusual economies in construction operations and gave the State the benefit of having construction more expeditiously completed than might have otherwise been the case. For details concerning the construction of these two contracts, reference may be made to page 17 of the July-August 1950 issue of *California Highways and Public Works*.

The completed construction provides four lanes in both directions for moving traffic. These lanes are 12 feet in width, consisting of 8-inch thickness of Portland concrete cement pavement on cement treated subgrade. Acceleration and deceleration lanes of adequate length are provided for all on and off ramps to the freeway. In general, rolled type combination curbs and gutters are provided throughout so that emergency parking entirely off the pavement can be obtained by drivers who find stopping necessary because of mechanical difficulties. The freeway is prohibiting parking or stopping of vehicles on the pavement throughout its entire length. Barrier type curbs are provided where bridge piers or other obstructions make it impossible to provide for safe off pavement parking and also at points where it is necessary to guide and direct traffic at the location of on and off ramps.

An engineering feature of great importance that should be mentioned is the construction of additional roadways for busses at the Alvarado Boulevard undercrossing. At this location the State was informed by the City of Los Angeles that bus companies to operate on the freeways required facilities of tranfer of passengers at this location. The city entered into an agreement with the State that the additional cost of constructing the bus turnout roadways and the stairways for the convenience of passengers would be paid for by the city. It is the intention of the city to seek reimbursement for the amount so expended from franchise fees which will be assessed against the bus companies utilizing these facilities.

The next and fourth unit of the Hollywood Freeway to be completed and opened to traffic will be a northwesterly extension between Virgil Avenue and Western Avenue. This 1.7 miles of construction is now in progress under contract with the Griffith Company. It is anticipated this construction will be completed during September of this year.

Including the Griffith Company contract, construction work now in progress on the Hollywood Freeway is as follows:

Big Right of Way Job

The District VII right of way organization is to be commended for the fine work done in obtaining and clearing rights of way for the Hollywood Freeway. As of this date, substantially all of the right of way needed for the Hollywood Freeway throughout its entire length has been obtained excepting for a few parcels largely in the Hollywood area that are yet to be acquired. Most of the parcels of land needed for the right of way were settled for by negotiation and only in a very few instances has it been necessary to resort to eminent domain proceedings. Indicating the extent and importance of the right of way work it is interesting to note that 1,643 buildings have been moved from the right of way and 76 buildings which it was not possible to move, have been demolished, and that the expenditure for right of way and utilities to date has been over $23,000,000.

The approved State Highway Budget for the next fiscal year (July 1, 1951 to June 30, 1952) which is now before the Legislature for adoption as a part of the Governor's Budget, contains allocation of funds for expenditure on the Santa Ana and Hollywood Freeways from the Los Angeles River to Vineland Avenue, as follows: For right of way acquisition, $1,000,000; for construction, $3,785,000.

These freeways join at Spring Street in the downtown Civic Center area and while these sums will be jointly available for both freeways it is anticipated that the larger portion of these funds will be expended on the Hollywood Freeway section. It is the intention of the State Division of Highways and the State Highway Commission to allocate sufficient funds in subsequent budgets so that the Hollywood Freeway can be completed throughout and opened to traffic by the end of 1953.

The California Highway Commission has allocated for the Fiscal Year 1951-52 on the Hollywood, Harbor, Santa Ana and Ramona Freeways a total in excess of $17,500,000.

Description	Contractor	Resident Engineer	Estimated construction cost (including engineering)
Eight-lane Freeway, Western Avenue-Virgil Avenue	Griffith Company	John Ritter	$1,719,000
Wilton Place Overcrossing	Geo. W. Peterson and Jack W. Baker	W. B. James	352,000
Hollywood-Santa Monica Grade Separation	Chas. MacClosky	W. A. McIntyre	592,000
Fountain Avenue Overcrossing	Oberg Constr. Co.	C. B. Oustad	362,000
Sunset Boulevard Overcrossing	Lars Oberg	J. M. Peterson	343,000
Van Ness Avenue Overcrossing	J. E. Haddock	L. E. Crayne	358,000

OLD FORT MOORE HILL IN LOS ANGELES GIVES WAY TO FREEWAY

Once the scene of battle, later the site of the town's gallows, and still later the center of the social life of the lusty, growing City of Los Angeles, old Fort Moore Hill has disappeared before the march of freeway progress.

Costing over $1,000,000, the contract to remove some 900,000 cubic yards of material has been completed. The contract, signed in January, 1949, included the construction of the Broadway overcrossing bridge. Work on this immense project started on March 31, 1949, and the completion date for removal of all this material has finally arrived.

It was no easy job to do. Much planning was done before the original specifications were written. More planning was done by all the contractors who placed their bids for doing this job.

The Guy F. Atkinson Co. won the contract and installed a six cubic yard electric shovel to do the work. A special substation was installed by the Los Angeles Bureau of Power & Light as this shovel used 2,300 volts of electricity instead of the usual household current of 110 volts or the 600 volts of direct current used by streetcars.

This immense undertaking resulted from a three-way cooperative contract between the City of Los Angeles, the County of Los Angeles and the State Division of Highways. Under the agreement the city and the county allotted certain sums of moneys to the State Division of Highways, and the Division of Highways was given full control over the entire project.

Much of the preliminary work was done under the supervision of S. V. Cortelyou, Assistant State Highway Engineer in charge of District VIII. After Cortelyou retired, the final work

. . . Continued on page 20

UPPER—Site of original Fort Moore as it looked a year ago. CENTER—Fort Moore Hill today showing Hollywood Freeway crossed by Broadway in foreground and above it, Hill Street under construction. LOWER—The old Broadway Tunnel looking north and below it the modern highway which replaced it. Both photographs taken from same location looking north

Panamint Road

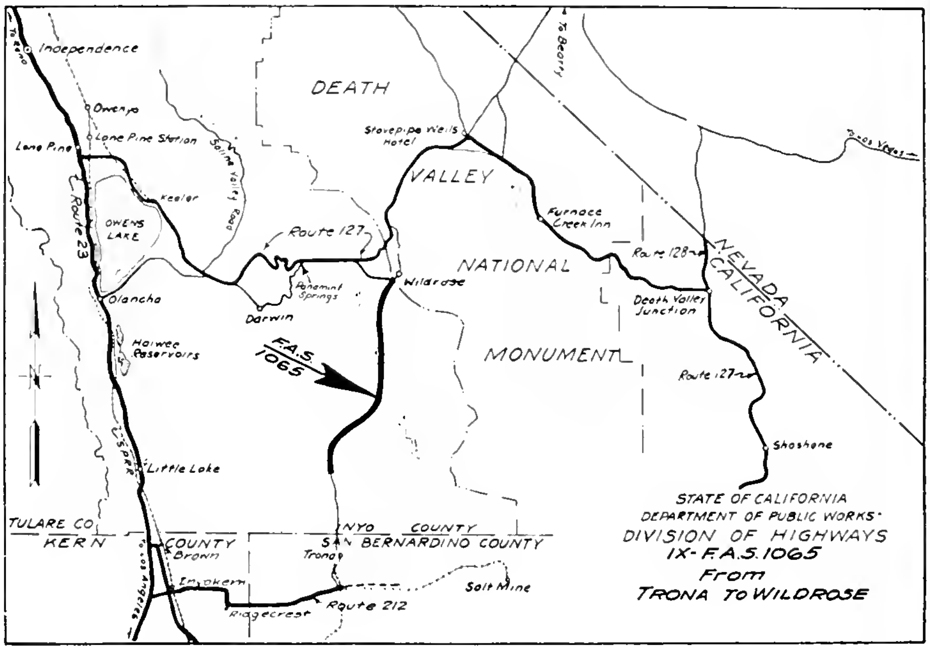
Inyo County Constructs 25.6 Miles of Federal Secondary Route 1065 Into Death Valley

By F. N. ROBERTS, Associate Highway Engineer

Lying just west of the Panamint Mountains and famous Death Valley, the recently completed Trona to Wildrose road provides a much needed improvement in one of the two westerly entrances to Death Valley National Monument. The improvement begins 11 miles north of Trona, end of an old oiled surface, crosses the Slate Range and Panamint Valley and enters the monument at the mouth of Wildrose Canyon.

It was financed from Federal Aid Secondary funds with supporting funds from Inyo County and was divided into three contracts.

The first contract, five miles in length, crosses the Slate Range and ends at Water Canyon at the foot of the north slope of the Slate Range. It was constructed by the Swedlow Engineering Company of Van Nuys. Arthur A. Johnson of Laguna Beach was the contractor on the second unit, 15 miles through Panamint Valley, leaving the five miles into Wildrose Canyon for the final contract completed later in 1949 by Dicco Inc. & Dix-Syl Construction Co. Inc., of Bakersfield.



Hard Rock Formations

On the north side of the Slate Range the slopes are precipitous and a great many different formations of rock were encountered during construction, some of which were so hard and abrasive that the ordinary pneumatic drill bit would hardly make an impression.

Ordinary roadway excavation was accomplished by bulldozers and carry-alls. In the rocky areas it was done by power shovels with bulldozers pioneering the cuts and making construction roads.

The second and third units were constructed by carry-alls and dozers. No water was used on the project as the distance to water made its cost prohibitive. A minimum of 85 percent compaction was maintained. Owing to the prevailing low rainfall it is probable that the condition of the roadbed will not be affected by moisture.

Eight percent is the maximum grade and 168 feet is the minimum radius of curvature. A penetration treatment of three-fourths gallon of SC-2 or SC-3 per square yard was used. Imported borrow as topping material covers almost the entire project. The county proposes to place a blanket of road-mixed surfacing on top of the penetration in the near future.

High Grades Eliminated

The new road replaces several existing roads which were used at different times in prior years and which have grade as high as 20 percent and are one-way with only occasional turnouts for passing.

Panamint Valley and the mountains on each side were the scene of much mining activity in earlier days. It is only a short distance from Bad Water in Death Valley to the scene of construction as the crow flies, but the towering Panamint Mountains with Telescope Peak rising to an elevation above 11,000 feet present an almost impassable barrier between the two valleys. Some of the famous old mines are the Modoc, the Panamint, the Minnietta, the Burro and the World Beater. The ghost town of Ballarat is located in the valley while Panamint City was located high in Surprise Canyon in the Panamint Mountains. The first ore from the Modoc mine was transported over the Argus Range to San Pedro and shipped to Swansea, England, where the only process which would extract the value was in operation at that time. Later it was shipped to Darwin when the smelter was built there and still later it had its own smelter at the mine.

Old Kilns Restored

There was also a smelter at Panamint City. Charcoal for all the smelters was supplied from the kilns at the head of Wildrose Canyon. These kilns have been restored to their original condition and are now one of the main points of interest in Death Valley National Monument.

UPPER—Looking north into Panamint Valley from north side of Slote Ronge, showing old Nadeou Rood. LOWER—New road climbing out of Ponamint Valley toward Wildrose

History of the roads in this area is as colorful as the mining activity. In the early days it was a gigantic task to supply the mining towns and to transport the ore or bullion out. A stage line ran from Mojave through what is now Trona, over the Slate Range at the site of the present crossing, to Ballarat and Panamint City on the east side of the valley, crossing the north end to the Modoc, thence south to Shepard Canyon, across the Argus Range to Darwin which in those days was larger than the City of Los Angeles.

First Road

Remi Nadeau, an old time freighter, was responsible for constructing a road on the west side of the Panamint Valley serving the mines on that side and crossing the Slate Range at the south end of the valley. This road stills bears his name but fell into disuse when the mining activity ceased, and is now impassable to the ordinary car except from Water Canyon south, which portion has been used up to the present time. Much Chinese labor was used in its construction and the mammoth task is evidenced by the many hand placed rock slopes used in retaining the embankment on the steep side slopes, still standing and usable to date.

In later years when mining stopped and Death Valley was made a national monument the present road was constructed more nearly in the center of the Panamint Valley from the mouth of Wildrose Canyon to a connection with the Nadeau road at Water Canyon, making a new connection with the road leading to Ballarat, Panamint City and Indian Ranch.

Maintenance of the roads in this vicinity up to 1930 was spasmodic and consisted of light dragging supplemented by laborers hand picking rocks from the surface. A light coating of gravel was spread by the Civilian Conservation Corps but this improvement was nullified by the increased travel which badly corrugated the surface and increased the burden of maintenance.

The increasing travel through Trona into Death Valley from 1935 on made some improvement in the roads seem necessary. In 1937 efforts to obtain improvement were started but it was not until 1945 that funds became available through the FAS program. The project was completed late in 1949 in time for the Death Valley Centennial Celebration. With the addition of the proposed road-mixed surfacing this highway should serve increasing tourist traffic for many years.

UPPER—Panamint City, showing ruins of old smelter and brick furnaces, the foundations of which were hand-hewn rock. LOWER—Old ghost town of Ballarat. "Seldom Seen Slim," veteran prospector, is the only inhabitant

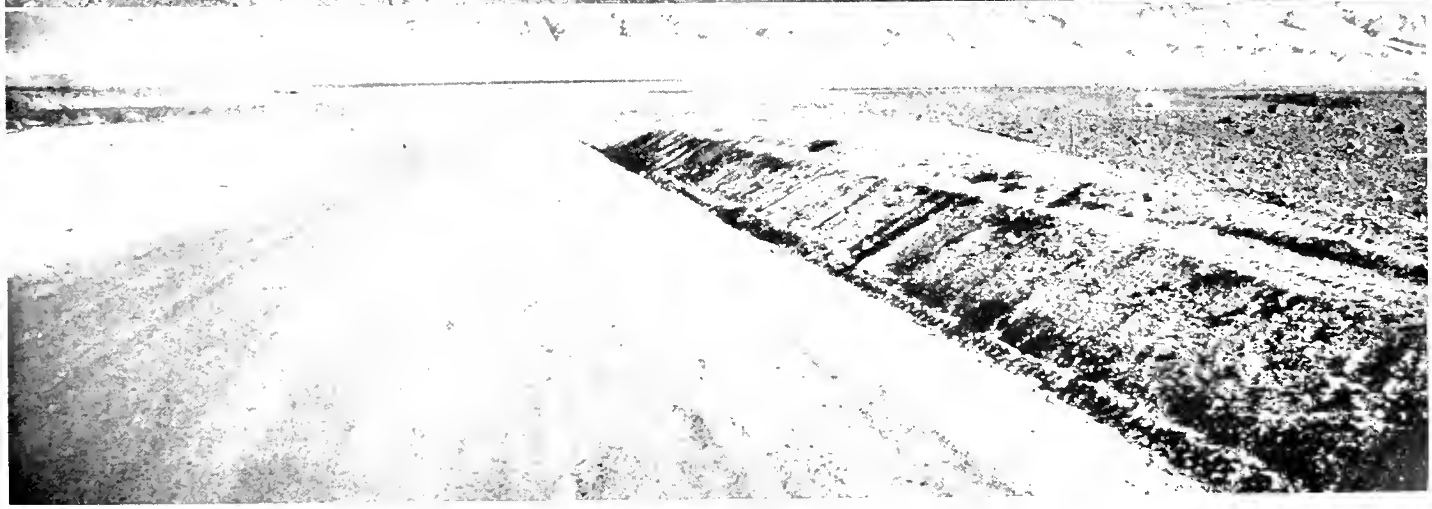
Old Fort Moore Hill

Continued from page 17 . . .

is coming under the direction of Paul O. Harding, present Assistant State Highway Engineer now in charge of District VII.

Practically all the resources of the State Division of Highways have been involved in the engineering features of this undertaking. Excavating and removal of the hill and the old Broadway Tunnel are but two of many problems that confronted the engineers when the decision was made for the routes of the freeway program. Drainage, bridges, entrances and exits to and from the freeway, traffic problems, right of way problems, everything has entered into this freeway program.

UPPER—New road at summit of Slate Range. Panamint Valley below. CENTER—New road winding down Slate Range into Panamint Valley. LOWER—New road through Panamint Valley



The preliminary design problem, therefore, became not only one of selecting the most suitable structure for the terrain but also of providing a bridge type and style which did not conflict in appearance with the existing bridge.

Many Types and Styles

Studies were made for many types and styles of bridges. Some of the types given consideration were arch bridges of three, five, and seven spans, each with two, four, six, or eight ribs; Roman viaduct style bridges; long steel beam spans and deck trusses on high piers; and box girders on round, modernistic concrete pier shafts. The latter had many favorable aspects when considered for the natural site alone, but with the existing multi-span arch bridge the contrast in types made it seem out of place. Arch bridges of five and seven spans were too near the general arrangement of the existing bridge, and, due to a decided difference in profile of the two crossings, the short arch spans had too much height for their length which, with the wider roadway, made them extremely incongruous in appearance. Studies were made for double-decked bridges in an effort to overcome the difficulties of the single level deck by making the structure narrower. These, however, showed no improvement in appearance or economy.

As the studies progressed the three-arch span bridge with the single deck gained in favor. This structure is of the same general style as the existing structure but of sufficient difference in number and size of spans to afford a pleasing contrast. There is no harsh clashing between this style and the existing conventional style arch but rather a development from the smaller, more ornate architecture of the past generation to the larger and plainer architecture of the present giving a mute approval of the type selected by the original builders.

Detailed Studies

More detailed studies were made to determine proportions for piers and spans, the location of piers and abutments, length and type of approaches, architectural treatment and economy of design.

The first attempts to tie the two structures together architecturally were to use similar style arch ribs and piers, but due to the width of the proposed bridge six or eight ribs were required. This large number of ribs resulted in confusion of lines rather than grace and lightness. The type of structure selected maintains the same similarity between individual parts and over-all dimensions as that of the existing bridge. The two ribs and pier shafts are wide transversely and relatively thin in elevation. The spandrel columns are proportioned similarly to minimize the massive members required for the wide roadway and heavy loads. By decreasing the number of parts it was possible to maintain harmony between the appearance of the two structures. No further attempts for similarity of architectural design were made.

Design of Deck System

One of the first problems confronting the structural designers was the layout and design of the deck system. This was complicated by the excessive cantilever of deck slab from the exterior girder due to the curve on spans 6 and 7 and the variable spacing of longitudinal beams on spans 7 and 8 due to the flared east end.

The length of the cantilever arm varies from 9 feet to 14 feet 6 inches, with bending moments up to 50,000-foot pounds. Previous experience with similar but lighter contruction indicated that the usual working stresses would entail considerable cracking of the deck due to elongation of reinforcement. The resultant cracks are not only unsightly but as they progress the conditions upon which wheel load distribution formulas are based no longer prevail and progressive failure occurs.

Working Stresses

Two methods were adopted to alleviate the condition: allowable working stresses in the tensile reinforcement were reduced below the standard American Association of State Highway Officials specifications, and longitudinal distribution of wheel loads by steel reinforcement, as required by the specifications, was augmented by a girder type curb and rail secured to the edge of the slab with stirrups. Area of tensile reinforcement was computed on the basis of a balanced slab design with allowable stresses of 1,000 psi for concrete and 18,000 psi for steel reinforcing. The thickness of slab was then increased to reduce the maximum concrete and steel stresses to 750 psi or 13,500 psi, respectively. This method was used to maintain maximum spacing of reinforcement and for economy. It was estimated that under prevailing prices it was more economical to increase the quantity of concrete rather than the quantity of steel.

Interior Deck Panels

The interior deck panels were computed for the standard allowable working stresses. The only variation from customary design procedure on the interior deck panels was use of four-way reinforcing for the slab. Due to the variable widths many of the panels were nearly square, requiring reinforcement in four directions.

Another deviation from usual design practice was the elimination of the longitudinal expansion joint usually required to decrease transverse temperature stresses in extremely wide bridges. The majority of wide structures are on short rigid columns with little possibility of movement without developing critical temperature stresses. The columns of this bridge, however, are either long and relatively flexible or attached to elastic arch ribs which allow temperature movement without excessive stresses. As the structure is in an active earthquake zone, monolithic construction was considered of sufficient importance to forego the advantages of the expansion joint. Later, more accurate and detailed calculations indicated this choice to be desirable though temperature stresses in the spandrel columns were difficult to establish.

Design of Arch Ribs

The design of the arch ribs presented several unusual problems. Span 6 is a 230-foot span on the centerline of a 2,000-foot radius curve, with the left rib 5.5 feet longer than the right. Span 7 is a 319-foot span partially (45 feet) on the 2,000-foot radius curve, however, the major portion is on the flared roadway which requires a variation of

PHOTO 3—This is a photograph of a model of the new Colorado Street Bridge, showing the existing bridge on the right

seven feet in the distance between the ends of the arch ribs to compensate for the increased width. Span 8 is another 230-foot span, all of which is on the flared section.

The centers of the ribs are 55 feet and 70 feet apart at Piers 8 and 9, respectively, and the ribs are varied from 24 feet to 32 feet wide to secure adequate column spacing for the deck structure. No two points of springing are at the same elevation, making all arches unsymmetrical. Even the center arch, which had originally been planned as a symmetrical arch, required a 12-foot difference in elevation between the two ends. The entire bridge is on an ascending grade of 1.0 percent, giving unequal column loads at what would usually be corresponding points. This difference in loads is further aggravated by the increasing width and heaviness of superstructure and the widened rib in Span 8.

Trial Rib Selection

The trial rib was selected by a method based on the use of elliptical segments for the arch axis. After selecting the trial rib a dead load force polygon was drawn. This first polygon was disconcerting for there were more than the usual discrepancies between polygon and axis, and selection of the correct axis depended on adjusting the location of crown as well as changing the rise-span ratio of the unsymmetrical arch rib. The rib axes were determined by use of a grid system based on axes for two assumed positions of crown and rise ratio which would enclose the correct rib axis. By computing the elevation of the quarter point for the several positions of crown and different rise ratios, it was possible to select, by interpolation, an axis conforming to the dead load force polygon. The choice of these two trial axes for Span 6 was not sufficiently wide to enclose the true axis, but the location of the latter was accurately determined by extrapolation. Many days of design time were saved by these methods, especially when compared to the tedius "cut and dry" methods of establishing a multi-centered arch axis.

Curb Design

The curb design was influenced by safety considerations, distributing beam effect, mentioned above, and architecture. The junction of the "on and off" ramps near the center and over the highest point of the bridge will be an area of weaving traffic, and motorists maneuvering for position in traffic lanes will make this section more of a hazard than is ordinarily encountered on a bridge. A standard rail designed for 300 pounds horizontal load per foot of rail was not considered adequate for this location and a safety curb was provided with a heavy horizontal steel rail member above the double nine-inch curbs. However, when contemplating the architectural details of the bridge this curb appeared too narrow for its

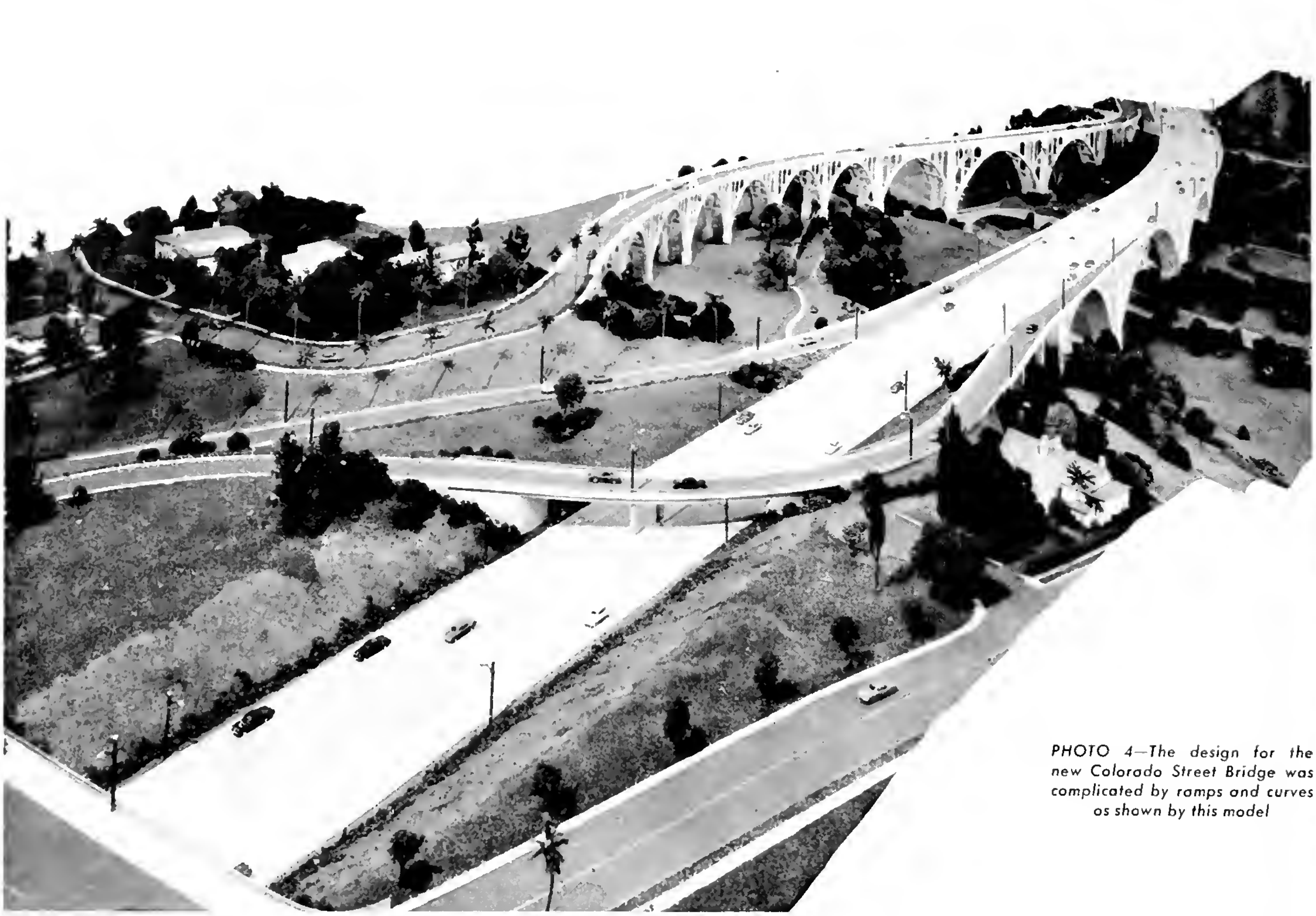


PHOTO 4—The design for the new Colorado Street Bridge was complicated by ramps and curves as shown by this model

length, being only two feet high on the outer face. The solid or safety curb portion of the rail was increased to 2 feet 3 inches high and the steel member reduced to a minor portion of the rail. This made the outer face three feet high, an increase of 50 percent for appearance; increased the rigidity of the curb so that it would be effective as a distribution beam; and, being higher, added to the safety feature of the double curb.

Box Girder Approach Spans

In the preliminary studies for arch span superstructure the longitudinal deck beams were assumed as T-beams. There had been some discussion about the use of a curtain slab or L-shaped beam for the exterior beams to give added weight to the appearance of the superstructure. Detailed stress analysis of deck slab and beam stresses disposed of this question in a short time. Due to the heavy cantilever slab stresses, large negative moments and dead load shear reactions were induced in the exterior beams as well as torsional stresses which could not be resisted by either the T- or L-beams. Box girders were designed to carry these stresses over the outer columns and, for uniformity, were also used over the interior columns. This design added to the visible dimensions of these beams and made the arch superstructure similar to the conventional box girder approach spans, thus greatly improving the appearance of the bridge.

One of the greatest difficulties in designing wider, modern bridges is to use a minimum number of columns. One of the more satisfactory methods is to increase the load-carrying capacity of the individual column by using a wide column with greater spacing and, consequently, heavier cap beams. The dimensions of the individual members are also in better proportion to the over-all dimension of the structure, and the decreased amount of form work per yard of concrete tends toward lower unit costs. This bridge, having a roadway much wider than the length of the average multiple span bridge, was particularly difficult in this respect, especially at the flared east end. Bent 11 is 132 feet wide and the adjacent spans are only 70 and 60 feet long, respectively.

Spacing of Columns

Spacing and widths of the arch ribs determined the paired spacing of spandrel columns and pier columns. This paired arrangement was used on the west approach to maintain the maximum consistency of design, but this arrangement was due to the ramps, an odd number of columns, and greater spacing.

Footing conditions and foundation materials are very good at most of the piers and bents. A bedrock formation of granodiorite underlies the entire area. This rock formation, at footing elevations, has bearing values up to 20

tons per square foot. The exceptional conditions are where the overburden over the rock is excessive. At Pier 8 the overburden is from 25 to 30 feet thick and is composed of sand with gravel and some large boulders. This material is also water-bearing as Pier 8 is in the middle of the stream bed. At Pier 9 the footing is over an old slide location in the wall of the canyon, the face of the underlying rock is quite steep, and the footing elevations were varied 27 feet between opposite corners of the block to obtain adequate foundation material. The mantle at Abutment 12 is a silty sand with a low bearing value, and abutment footings had to be carried from 30 to 36 feet below grade. Portions of Abutment 1 are in an old, poorly compacted fill which is not stable and has moved causing considerable cracking of wingwalls of the Colorado Street Bridge. It will be necessary to use steel piling for foundations in this area. While these conditions complicated the details of design they can hardly be classed as serious or difficult.

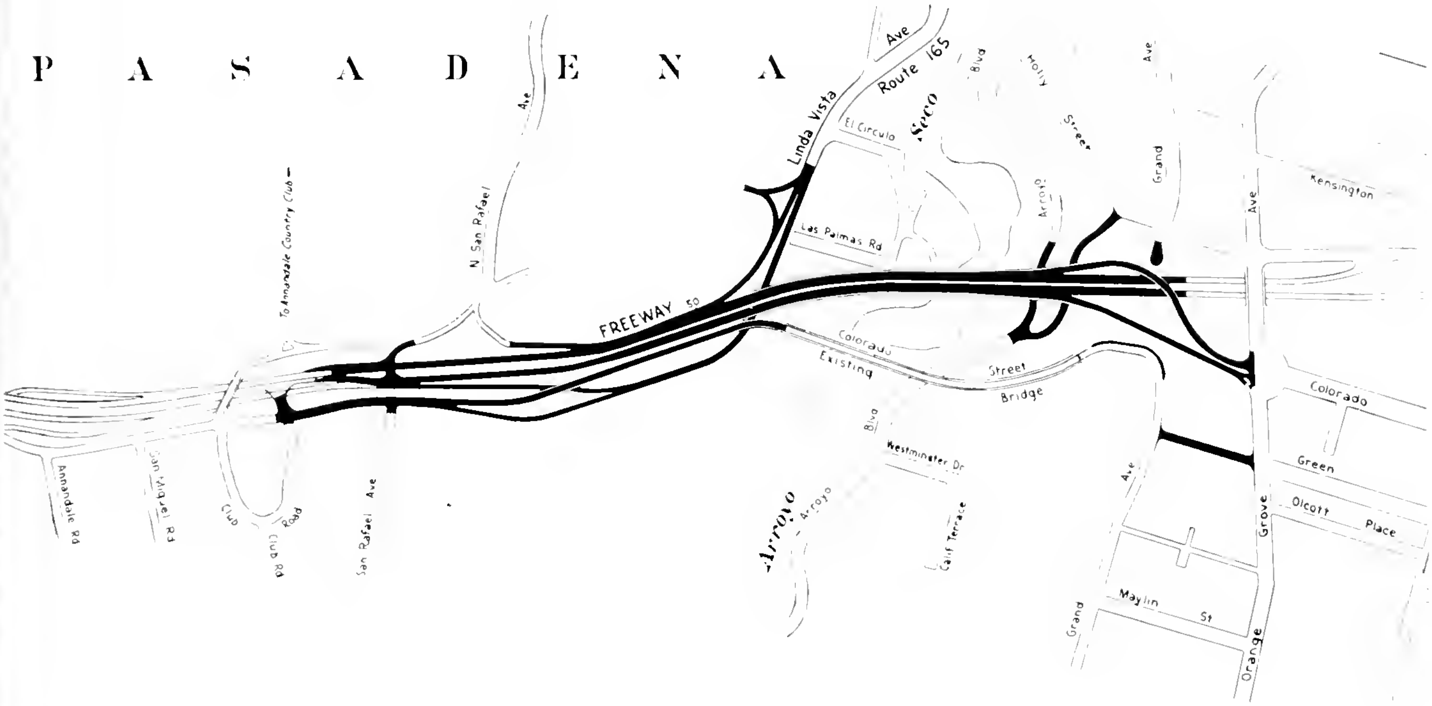
Pier 8 Impressive

Pier 8 is the most impressive portion of the structure. The twin pier blocks will be 60 feet high and 18 x 32 feet in cross-section. About 2,500 cubic yards of concrete will be required for the pier base and footing and 1,000 cubic yards for the columns. The 100-foot-high pier shafts were divided into four columns above the base. Structurally, these columns are sufficiently flexible to allow temperature movements without developing critical stresses or requiring use of expansion devices as needed on a solid shaft. Architecturally, a heavy solid shaft has no relationship with the narrow spandrel and approach columns, while the columns as designed do have similar proportions and less tendency to cut the bridge into five separate segments.

In concluding this description, a summary of dimensions and quantities is given for the statistically minded. The bridge is 1,364 feet long, 93 feet 6 inches wide at Abutment 1, and 171 feet 4 inches wide at Abutment 12. The deck is 130 feet above stream bed at Span 8. The clear spans of arch ribs are 214 feet, 302 feet, and 214 feet, respectively. Ribs for Spans 6 and 7 are 24 feet wide, and the rib for Span 8 varies from 24 to 32 feet in width. Crown thicknesses are 2 feet 6 inches and 3 feet for the 230- and 319-foot spans, respectively. Skewback thicknesses are 4 feet 3 inches and 4 feet 8 inches for the high and low ends, respectively, of Spans 6 and 8, and 5 feet 4 inches for Span 7. There are approximately 5,500 cubic yards of concrete in the arch ribs, 5,300 cubic yards of concrete in the arch piers and footings, and 32,000 cubic yards of concrete and 6,000,000 pounds of steel in the entire structure.

The architectural studies, sketches and drawings used in preliminary planning and designing were made by H. C. Van der Goes. H. E. Kuphal, Associate Bridge Engineer, made the original preliminary design studies and the arch rib design was based on his method of arch analysis, using elliptical segments for the axes. The writer has supervised the planning and design of the project since Mr. Kuphal's retirement in 1948. C. W. Jones, Senior Bridge Engineer, has had charge of the work done in the Los Angeles office of the bridge department and at the site. Messrs. R. S. Barker and P. H. Bowen, Associate Bridge Engineers, had charge of the structural design of arch spans and piers, and R. E. Fetter, Associate Bridge Engineer, had charge of the design of approaches and auxiliary structures.

This sketch shows the ultimate road system of the Colorado Freeway at Arroyo Seco Bridge



Flood Damage

Repairs on State Highways Hit By Storms Will Cost $3,400,000

By W. A. SMITH, Assistant Maintenance Engineer

DAMAGE to state highways in Northern California of more than $3,400,000 occurred from October 26th to the end of 1950. This is the most severe period that the State has experienced since the winter of 1937-38, when some $2,340,000 damage was done to highways in the north in December, 1937, and $5,660,000 damage to highways in the southern portion of the State in March, 1938. In the spring of 1941, storm damage totaling $2,500,000 occurred throughout the State.

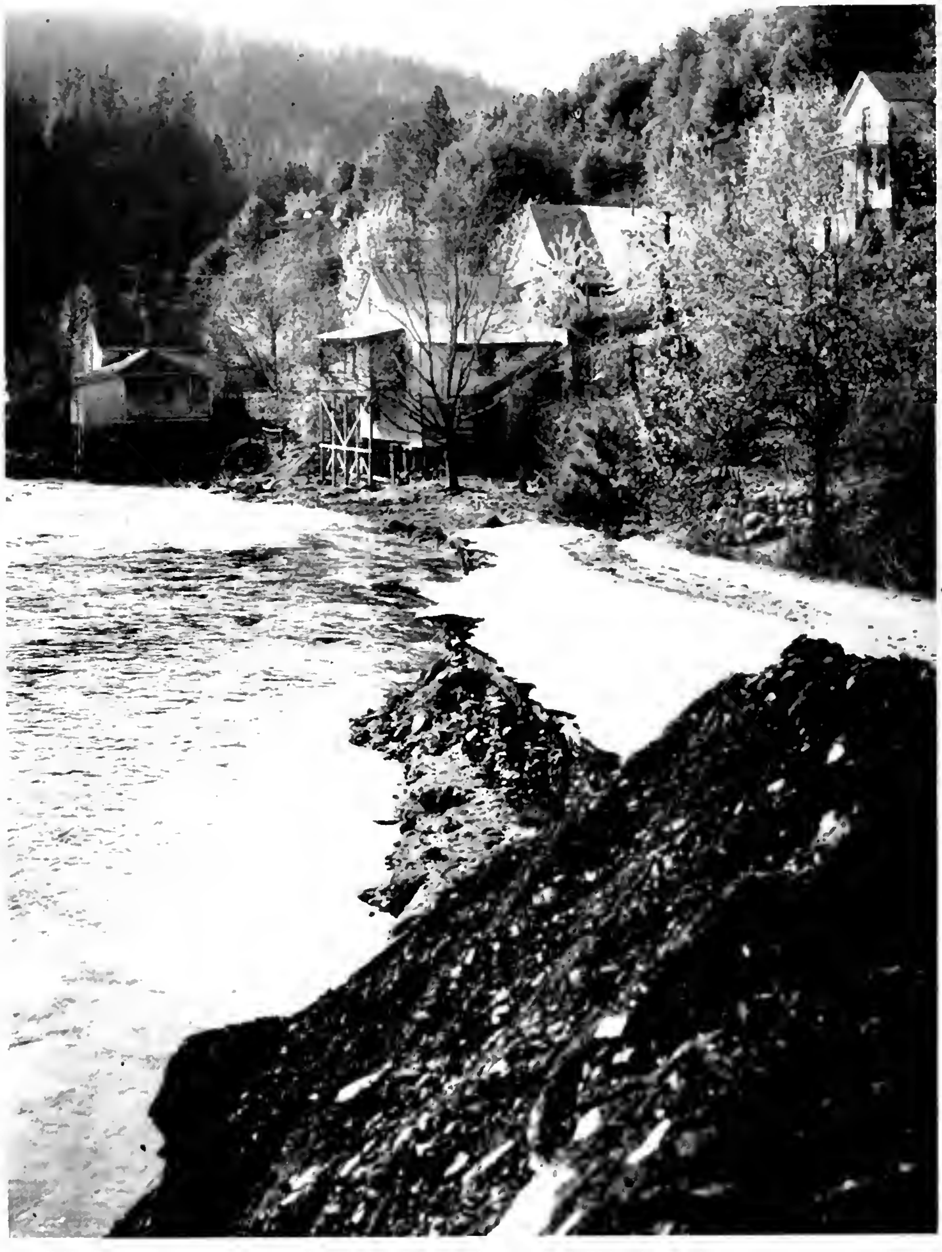
The October storm was mostly confined to the Smith River area east of Crescent City on U. S. 199. A total of 20 inches of rainfall was reported at Idlewild between October 26th and 28th. The damage consisted of undermining and washing out of protection work and fill slopes, although there was some damage to the roadway at two locations due to water over the pavement.

The damage which occurred during the November and December storm period was confined mainly to routes in the southern portion of the Sacramento Valley, the eastern portion of the San Joaquin Valley and the routes crossing the Sierra Nevada Mountains from Bakersfield north to Downieville.

Rains Destroy Snow Pack

At the start of the November storm, the snow line was at the 3,000-foot elevation with a depth of eight inches at Donner Summit. Records at the Soda Springs weather station show that 18.85 inches of rain fell between November 16th and November 21st, and 12.33 inches fell from December 3d to December 9th. The November storm took off the entire snow pack to augment the run-off which, in some streams, exceeded all previous records.

The total damage to state highways was approximately 10 percent of the total estimated property damage caused by the floods throughout the area. In the vicinity of Marysville, Sacramento, Stockton, Coachella and similar locations, the damage to homes and furnishings and to farm lands, stream protection works, etc., reached the proportions of a major disaster. Damage to state highways in these areas, with two exceptions, was minor at any one location, consisting of washing of shoulders and cut and fill slopes at many locations. The major highway loss in the valley areas was the destruction of the Paradise Cut Overflow bridge on U. S. 50, west of Mossdale, and of the Goose Slough bridge on



This section of Sign Route 49 between Downieville and Sierra City was heavily damaged by floodwater

UPPER—Flood damage on Sign Route 140, the All-year Highway into Yosemite Valley, just east of El Portal. LOWER—Bulldozer equipped with Caterpillar diesel tractor at work on Sign Route 140. (Photo courtesy Caterpillar Tractor Company)

UPPER—Floodwaters destroyed the Paradise Cut overflow bridge on U. S. 50 west of Mossdale. LOWER—Aerial closeup of the bridge which was undermined and collapsed. Westbound traffic lanes are under water

state highway Route 139 in Kern County.

Maintenance Crews Work Hard

The principal problems of highway maintenance forces in these areas have been the measures required to warn and protect traffic and to protect highway facilities. As a general thing, the locations where trouble could be expected were well known from past experience. The most practical routes for detours could be decided quickly and signs and barricades were on hand in sufficient quantities in each area so that the local forces could act with the minimum of outside aid and instruction.

Every available man was pressed into service, of course, and each crew involved worked extra shifts to whatever extent was necessary. In the Truckee territory, for example, the normal time for the 40-man crew for the last half of November totaled 4,800 hours. This crew accumulated some 2,600 hours of overtime during the period. This represented the addition of the equivalent of 22 men, or an increase of over 50 percent in rate of expenditure of maintenance funds.

Debris Creates Problem

It was necessary also, in all areas where there was extensive damage, to rent power shovels, tractor units with bulldozer, heavy trucks, large scrapers, and other construction equipment. This type of equipment is not ordinarily required on maintenance work. It is rented fully manned and operated. The cost of operating this special

UPPER—Slide on Mt. Diablo Road, State Route 75, in Contra Costa County near Orinda. (Photo by San Francisco Examiner.)
LOWER—Heavy equipment clearing U. S. 50 at Camp Sacramento

equipment was an additional drain on maintenance funds.

In most watershed areas, the last flood of any consequence was in 1941. During the intervening period, a great deal of debris such as brush and fallen timber had accumulated. This debris was picked up by the flood water and washed into the main channels. The bridges with supports in the streams were endangered by this flow; in fact, the loss of the Goose Slough bridge in Kern County was due to this cause. A great deal of effort was required in clearing drift which lodged against major structures. It was necessary in some cases to secure dragline outfits and, in at least one case, a tug boat used. There was an almost constant patrol maintained of all highways in the areas affected in an effort to keep drainage channels and structures clear in order to minimize the damage.

Major Damage

The major damage which occurred during the storm period was in the mountain areas, with the two exceptions noted above, and is summarized as follows:

Bridges	Number
Approaches washed out	22
Foundation or structural damage	12

Destroyed, or complete replacement required, as follows:

Deep Creek	Tul-10-C
Goose Slough	Ker-139-A
Silver Creek-Paradise Cut Overflow	Alp-24-C SJ-5-B

Roadway	
Completely washed out on various sections of eight major routes	5.2 mi.
Partially washed out on the same eight routes	2.1 mi.

The routes following were closed to all traffic for varying periods of a few days for some routes and up to nine days for U. S. 40, due to the washout at Mystic near the California-Nevada state line, and from November 20th to December 18th, for the section of U. S. 395 in the Walker River Canyon north of Coleville. The damaged section of U. S. 50 in the vicinity of Mossdale was closed from December 10, 1950, to January 5, 1951.

Road Closures

The main road closures in the mountain areas, as a result of major damage to roadway facilities, were at the following locations:

U. S. 40 was closed by a washout at Mystic near the California-Nevada state line for nine days

Number	Name	Location
Cal. 49	Yuba Pass	East and west of Downieville
U. S. 40	Donner Summit	Vicinity of Mystic near the Cal.-Nev. state line
U. S. 50	Echo Summit	At Camp Sacramento
Cal. 4	Along Carson River	East of Woodfords
U. S. 395	Walker River Canyon	North of Coleville
Cal. 140	All Year Highway	Merced River Canyon in the vicinity of Briceburg
Cal. 178	Kern River Canyon	Between the mouth of the Canyon and Bodfish

In addition to the above, highways were closed for various periods at many locations, including U. S. 99, south of Marysville, state highway Route 98 at Sacramento, and U. S. 50 at Mossdale, as previously mentioned.

Maintenance Budget Supplemented

The maintenance budget for the fiscal year, ending June 30, 1951, included an item of some $1,400,000, which was reserved to finance cost of slide removal and storm damage repairs. This reserve was based on estimates for a normal year. As of January 1, 1951, allocations from this reserve

The rampaging Kern River washed out this section of Sign Route 178 in Kern County

totaled about $1,484,000. This includes allocations for removal of the large slide on the Tunnel Road near Orinda in Contra Costa County, State Highway 75, and a number of similar emergency projects along the coast.

It has already been necessary to supplement maintenance funds by $800,000. The repair work which has been done on the main routes is only sufficient to provide for traffic during the rest of the winter season. More permanent repairs, including extensive protection work, must be deferred until more favorable weather. Where damage occurred on routes in the federal aid system, a portion of the cost of permanent repairs will be financed from federal funds that have been granted for the purpose. Further allocations of state funds will be required to complete the financing of these projects, as well as the major repair projects on the routes not on the federal system. It may be anticipated also that extensive pavement failures may develop on sections of highways not particularly damaged by floods. The subgrades are so thoroughly saturated that proper support may not be available to carry the volume and weight of traffic. The extent of such failures cannot be foreseen or provision made to protect against them. There is no doubt, however, that the cost of repairs will add considerably to the over-all cost of maintenance during the 1951 season.

GOLDEN RULE

Keep in mind the "Golden Rule" of motoring when you drive. Be as courteous to other drivers as you would have them be to you.

CHANGING SIGNAL

When you think a "Go" signal is about to change, reduce your speed. Speeding up to beat a changing signal is a common cause of traffic accidents at signal-controlled intersections.

Montgomery Freeway *Will Relieve Traffic In South San Diego*

By W. T. RHODES, Associate Highway Engineer, and A. K. GILBERT, Associate Bridge Engineer

In 1943, approximately 8.70 miles of four-lane divided highway was completed by the California Division of Highways to serve the industrial district adjacent to the San Diego Harbor area in the City of San Diego. It was built primarily as a defense road to provide ready access to naval and marine training stations, the 11th District Naval Storehouses, Lindbergh Field, airplane manufacturing plants, and innumerable other industrial plants engaged in the manufacture of war materials.

This project, known as Harbor Boulevard, extended from Seventh Street in National City to the junction of Hugo and Rosecrans Streets on Point Loma.

Freeway 11 Miles Long

On August 21, 1947, the California Highway Commission adopted and passed a resolution to construct a freeway from the international border to the existing terminus of Harbor Boulevard at Seventh Street in National City.

The Montgomery Freeway which runs from San Diego to Tia Juana was named by legislative resolution in 1949, after John J. Montgomery, a pioneer in the development of gliders. It is said that he made the first glider flight in history in 1883, on his farm along the route of the present freeway. He was killed in the crash of a glider in 1911.

The freeway will be approximately 11 miles in length, and it will accelerate the movement of traffic in the so-called South Bay area south of San Diego. The proposed program of development indicates that the 11 miles of highway will be completed during the 1952-53 Fiscal Year.

Rapid Progress

On November 4, 1949, a contract was awarded for the construction of 2.92 miles of highway and eight bridges on the first section of the Montgomery Freeway. This section begins at H Street in Chula Vista and ends at 14th Street in National City. A contract to widen and improve the section between Seventh and 14th Streets in National City has recently been awarded and is now under construction by the R. E. Hazard Construction Company. Still another contract, for the construction of overcrossings at H Street in Chula Vista and Main Street near Palm City, has been awarded to the Charles MacClosky Company and work thereon began on July 10, 1950.

As of July 10, 1950, the joint venture contractors on the 2.92-mile section between Chula Vista and National City had completed 90 percent of the grading, and work on the eight bridges is 45 percent complete; March 1, 1951, is the tentative completion date.

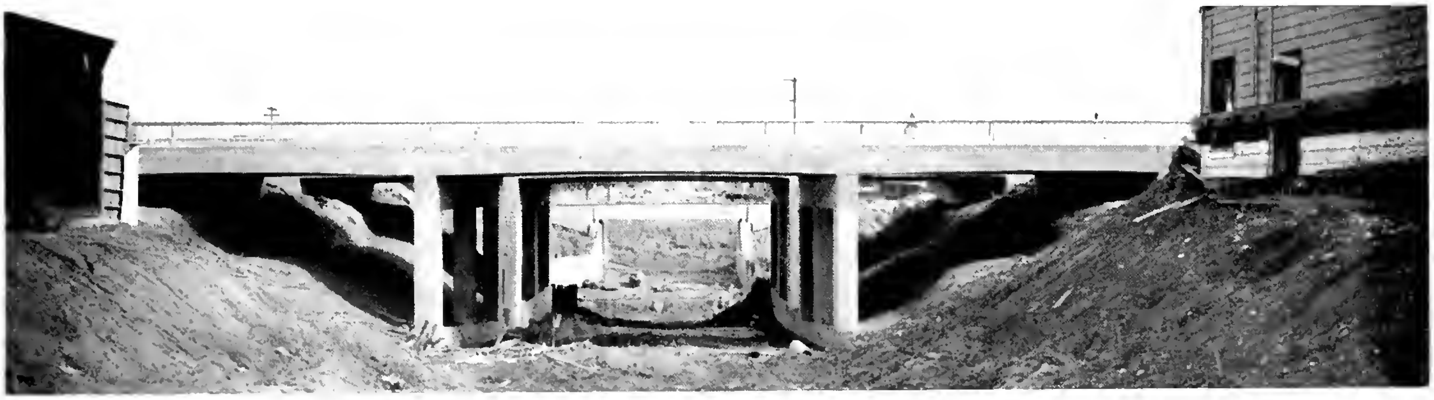
Roadway Details

The construction consists of grading and paving two separate roadways with a variable width dividing strip. The

This map shows the general location of the project between San Ysidro and Seventh Street in National City on State Route 2 and the relationship to other state highways in the area.

This is the Sweetwater River channel bridge

plant-mix pavement, three inches in thickness, is to be placed on 13 inches of selected base material of which the top eight inches is to be stabilized by cement treatment. Each roadway will be 24 feet wide with a 3-foot shoulder on the outer side, and a 2-foot shoulder on the side adjacent to the median strip. Access to the northbound and southbound roadways is provided at E Street in Chula Vista and 18th Street in National City; and an outer highway is to be constructed on the west of the southbound roadway between G Street and D Street in Chula Vista.



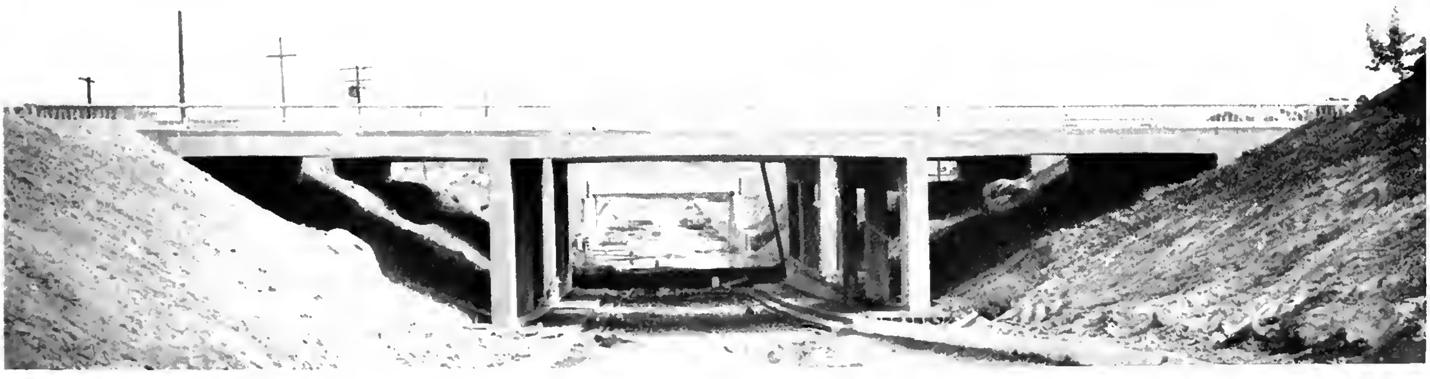
This is the 18th Street Union Pacific undercrossing in National City

Southbound Roadway

In constructing the southbound roadway, for a distance of approximately one mile across Sweetwater Slough, it was found necessary to remove unsuitable material to a minimum depth of five feet prior to placement of the embankment, which consisted of coarse, sandy material from the cut section south of the slough.

In general the layout line of the Freeway is located approximately 125 feet west of Bay Boulevard. However, in order to utilize two existing bridges at North and South Sweetwater, plans were made to widen and raise the grade of Bay Boulevard for a distance of one mile across the slough and use it for northbound traffic.

This is the 24th Street Union Pacific undercrossing structure in National City



This is the F Street Union Pacific bridge in Chula Vista

Grade Separations

Eight bridges and grade separations were constructed as part of the project:

The F Street Underpass is a structural steel plate girder bridge consisting of two spans each 50 feet 10 inches long supported on reinforced concrete abutments and a center bent to carry a branch line of the San Diego and Arizona Eastern Railway over the freeway.

The E Street Overcrossing is a reinforced concrete slab bridge consisting of two spans each 52 feet 4 inches long supported on concrete abutments and a center pier. It provides a 26-foot roadway over the freeway for traffic entering the industrial and agricultural district from the vicinity of Chula Vista.

Sweetwater River Bridge

A new bridge across the south channel of Sweetwater River, consisting of 15 deck slab spans on concrete piles, was constructed to carry the southbound roadway; whereas the northbound roadway will utilize an existing bridge on Bay Boulevard, which was built in 1945. To provide adequate waterway area this bridge was lengthened approximately 231 feet by constructing 10 additional 23-foot spans.

The southbound roadway crosses the North Sweetwater channel on a new structure, consisting of eight deck slab spans on concrete piles. This crossing is approximately 171 feet in length. Here again an existing bridge on Bay Boulevard was utilized, after lengthening, for northbound traffic.

Access to the residential and industrial districts located west of Montgomery Freeway in National City was provided for by construction of undercrossings at 18th and 24th Streets. The two separations are identical, each consisting of a pair of reinforced concrete slab bridges carrying the freeway over the two streets. Each structure consists of one 40-foot span and two

. . . *Continued on page 61*

This is the E Street freeway overcrossing in Chula Vista

Certificate of Commendation Given Boorman

THE FIRST employee of the Department of Public Works to receive recognition by the State Merit Award Board was presented with a Certificate of Commendation by Director C. H. Purcell at a ceremony in Sacramento on January 26th.

Wetherby Boorman, a Division of Highways' employee at the Burlingame Maintenance Station, received the award for recommending an improvement in the catalog issued by the Service and Supply Department of the Division of Highways. The suggestion, now being put into effect, is to extend the present practice of showing the amounts or quantities of items according to standard factory packaging, thus enabling more efficient requisition and supply to various State field units.

G. T. McCoy, State Highway Engineer, G. F. Hellesoe, Maintenance Engineer, A. E. Cooper, Highway Superintendent at Burlingame, Frank B. Durkee, Department Chairman of the Merit Award Program, and Rodney C. Richardson, Assistant to Director, were present to witness the award, which was signed by Governor Earl Warren.

Milton Harris, Stores Engineer, states that the practice has been partially in effect, but that Boorman's suggestion has focused attention on the need and economy of expanding this catalog service. Possible state-wide adoption of the idea is being studied by the Division of Purchasing, Department of Finance.

This presentation is a part of the State Merit Award Program, enacted by the State Legislature in 1949. Fred W. Links, Assistant Director of Finance, is chairman of the five-man board, made up of State employees.

Boorman resides with his family at 132 San Benito Avenue, Lomita Park, and has been an employee of the Division of Highways for approximately 10 years.

State of California

Certificate of Commendation

This Certificate is awarded to

Wetherby Boorman

as official recognition and appreciation for individual initiative and resourcefulness while employed by the State of California in making a valuable contribution to the improvement of the operation of State government.

Dated at Sacramento, California this *16th* day of *January* 19*51*

Governor

Attest:

Secretary of State

Countersigned:

Chairman, State Merit Award Board

Director of Public Works C. H. Purcell presents certificate of commendation to Wetherby Boorman. State Highway Engineer George T. McCoy on right

APPLICATION OF THE CALIFORNIA COORDINATE SYSTEM TO HIGHWAY SURVEYS AND RIGHT OF WAY ENGINEERING

By H. C. DARLING, District Locating Engineer and
L. M. PETERSEN, District Right of Way Engineer, District IV

SURVEYS play an indispensable part in providing highway service. They provide a portion of the basic data necessary for design; they provide information for acquisition of right of way; they direct the contractor's operations during construction; they determine final pay quantities and provide an "as built" record to be used for maintenance and future betterments or reconstruction.

While the cost of surveys is but a small percentage of the total cost of a modern highway, the total annual expenditure for surveys is considerable. In District IV alone, out of an annual total of approximately $2,000,000 in preliminary and construction engineering funds, about $300,000 is expended on surveys. These surveys are nearly all made with reasonable accuracy and are carefully adjusted, therefore would serve as a useful permanent record. Such surveys, if anchored to a state-wide and nation-wide network, become a part of that network, and therefore would be a permanent record continuing to serve far beyond their initial intended purpose.

Basic Network

To accomplish this objective there has been established by legislative action in California a basic network known as the "California Coordinate System." While the system has been in use but a short time, it is already true in some counties throughout the State that county, city and private surveys, which have been tied to the coordinate system, have been used by the Division of Highways at material savings in survey costs. Likewise surveys by the division have been used by others to their benefit. This cooperation is in its infancy; however, it now can be seen that the end result is going to be a material savings in survey costs to everyone concerned, including the division.

History of Systems

Before discussing the more technical details of having special purpose surveys tied to the California Coordinate System, the history of coordinate systems will be briefly reviewed.

An article on Plane Coordinates for Highway Maps was presented by J. C. Carpenter of the Division of Highway Transport before the Programing and Planning Engineers during March, 1948, and was distributed to the Division Engineers of the Public Roads Administration by H. S. Fairbank, Deputy Commissioner. Copies of this article were distributed to the various districts in the Division of Highways on July 22, 1948. Following is a short resume of this article.

In 1784, Thomas Jefferson was named chairman of a committee appointed by Congress to draft a plan for the survey and disposal of the western territory of the United States, and in Jefferson's own handwriting, the committee recommended a plan for the survey and sale of this most valuable area in the world. Under the scheme thus adopted, the standard parallels were projected westerly across the Country and principal meridians were located to cut this virgin area with squares 24 miles on a side. These were then divided into six-mile square townships and finally into the mile-square sections so familiar to all citizens. This rectangular plan of subdivisions and indexing is undoubtedly the most convenient ever devised by any nation. The first township was surveyed in 1785, and during the nineteenth century, the entire public domain was thus subdivided.

More Accurate Controls

As land values increased across the Country, the U. S. Coast and Geodetic Survey realized that more accurate controls would have to be established; and the coasts of this Country were tied together by extensive systems of triangulation arcs. This development allowed the true determination of any point within this area. This practice was then simplified when the U. S. Coast and Geodetic Survey promulgated the plane coordinate policy, and this system has been adopted by 24 states.

In 1933, Geo. F. Syme, Highway Engineer, North Carolina State Highway Department, made the first request to the Coast and Geodetic Survey that it suggest a plan for utilizing the geodetic data over an entire state which would involve only the formulae for plane surveying. This brought about the establishment of the North Carolina Coordinate System, by means of which the latitudes and longitudes of triangulation stations could be transformed into rectilinear coordinates on a single grid. Other states have since adopted similar systems using either the transverse Mercator or the Lambert projections.

States Divided Into Zones

Under these schemes, the various states are divided into different zones, and the type of projection used depends on the shape of the state in question. For one of limited east-and-west dimension, the transverse Mercator projection is used, while for California, the Lambert projection was selected as California's east and west dimension meets its requirements. This projection is more familiarly known as the "Lambert Grid."

The Lambert projection is named after Johann Heinrich Lambert, an Alsatian, who devised it in 1772. Essentially it employs a cone intersecting the spheroid at two parallels of latitude known as standard parallels for the area to be represented, as shown in *Figure 1*. The cone is centered on the

polar axis of the earth. When the conical surface is split along an element, it can then be unrolled in a plane and the parallels of latitude become arcs of concentric circles. The meridians of longitude are straight lines on the rolled out cone converging at the peak of the cone. On this flat projection grid lines are drawn, equally spaced, and at right angles to each other. These lines represent the Lambert grid and the X and Y distances from the origin are the coordinates as in any system of rectangular coordinates. The right hand section of *Figure 1* represents a section of the cone unrolled in a plane.

The vertical lines are parallel to the central meridian which is a longitude line near the center of the zone. The origin of the X coordinate is moved to the left or west 2,000,000 feet from the central meridian. The origin of the Y coordinates is placed below the southern edge of the zone. In each zone the X and Y coordinates are always positive and the X coordinate is always larger than the Y coordinate.

Standard Parallels

The standard parallels are placed not more than 112 miles apart. For this spacing at our latitudes the relation of the length along the curved surface to the plane length along the conical projection will be such that the accuracy will be within 1:10,000. The projection may extend beyond the two standard parallels about 22 miles for the same accuracy, making the maximum width of zone in the north and south direction about 156 miles. Between the two standard parallels of latitude the earth bulges out above the surface of the cone. The geodetic length, the length along the earth at sea level, will be greater than the grid length between the parallels and a factor less than unity needs to be applied to obtain correct grid length. At the standard parallels, the factor is unity; and outside, it is greater than unity.

There are seven zones in California, all extending across the State from west to east, except Zone 7 which covers Los Angeles County only. (*See Figure 2.*) Zone lines follow county boundaries so that a survey in any county may be made in one zone only. The Coast and Geodetic Survey has calculated the coordinates of both

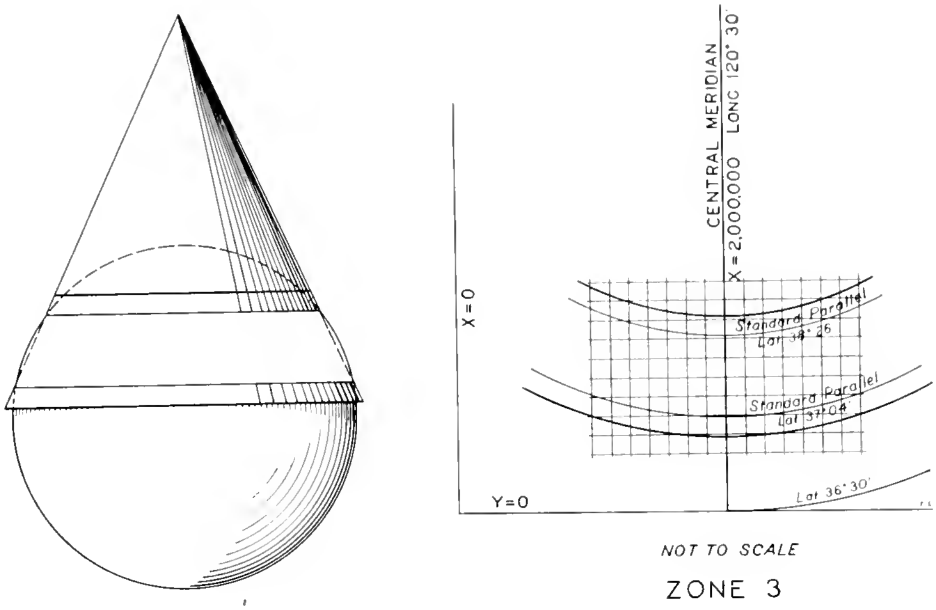


FIG. 1

zones for monuments that are near the edge of a zone. Many of our State Highway Districts have found that their district boundary includes more than one zone.

There is no convergence on the Lambert Grid as used in the California Coordinate System. A straight line run entirely across the State keeps the same bearing. The geodetic bearing would change several degrees.

State-wide System

The State-wide System of Plane Coordinates was enacted by the State Legislature under Chapter 1307, Statutes 1947. This is an act to define and officially adopt a state-wide system of plane coordinates, to provide for uniformity in the orientation of land surveys and maps within the State of California and is hereafter to be known and designated as the "California Coordinate System." It will become a part of the system of plane coordinates as established by the United States Coast and Geodetic Survey.

The State Highway Districts were officially notified by letter from Geo. T. McCoy, State Highway Engineer, on July 21, 1948, quoted in part as follows:

"In connection with development of surveys and preparation of plans, it is desired that our work be tied to the California Coordinate System." Further instructions were received from the then Deputy State Highway Engineer, Fred Grumm, on May 17, 1950, covering the use of plane coordinates in the preparation of deeds for property acquired as right of way.

Even before this act became effective, District IV had been using the plane coordinates as established by the United States Coast and Geodetic Survey in checking preliminary surveys to establish a more accurate preliminary line. The advantages obtained from use of these coordinates has more than offset the additional cost of tying in the surveys.

Best Method

The best method in the field is to occupy a monument for which Lambert Coordinates have been previously established, securing the proper orientation of bearings by sighting on another established monument, and then proceeding with the preliminary line to the end of project where another monument will be occupied and a check made on the bearings as recorded. If monuments are available along the route, ties should be made to them and azimuth closures made. If unable to occupy monuments at the beginning and end of the project, a triangulation should be made using as a base two established monuments. The triangulation should be so laid out that there are no small angles and all angles of the triangle should be turned by repetition and adjusted.

The same degree of accuracy should be used in chaining all courses of the preliminary line; and to eliminate all chances of one- to five-foot mistakes, the line should be "double chained." In general, the preliminary survey will not be a closed traverse in itself but becomes a part of the California Coordinate System. In order to accurately adjust the ground level distances to grid distances, no chaining errors should be prorated into the preliminary line. This was demonstrated in Santa Clara County along Routes 5 and 69 where monuments were occupied on both ends of the preliminary traverse, and a total error of 1.5 feet in 63,000 feet was found in the "Y" coordinate, the main direction of chaining. In this particular survey, angles were turned with a transit reading to one minute. Six measures were recorded for each angle, the telescope being reversed after three measures were made. In this case, the horizontal angle was measured between backsight and foresight in a clockwise order. The angular error in this particular survey amounted to 29 seconds.

Special Survey Party

In order to keep the field surveys well in advance of the priorities required by the Design Department, a special survey party was organized in District IV to carry the California Coordinate System to the preliminary line where this line can be readily adjusted; and when the final location is approved, it can be placed on the California Coordinate System entirely by office calculations with no further field work required. The advantages are evident at once; the plans for any portion can be made knowing that there will be no conflict in stationing and no equations on the layouts.

Precise instruments are used by this special survey party, tapes checked against a standard tape, allowances made for temperature, sag, and pull which require the use of a tension-handle and thermometer. This same accuracy should be used by the survey party engaged in the preliminary survey. The Chief of Party on this special work is responsible for all calculations; and in addition, it is planned that this party set bench marks along the location with a precise level.

FIG. 2

Costs Decreased

For the present, the cost of the preliminary surveys will be increased, but advantages gained should outweigh this additional cost; and practically all errors will be eliminated. In a few years when many of the major surveys in the district have been anchored to the coordinate system, it is expected that the cost of additional surveys in these areas will be considerably decreased.

The adjustment of the triangulation and traverse lines based on the California Coordinate System is similar to any other traverse adjustment. There are two main differences. One is that scale factors should be applied to measured distances. Another is that adjustments can be made between known points instead of by a closed loop.

First the azimuth of lines should be adjusted. If a horizon closure has been made at any of the points, the error should be placed equally in all angles turned around the point. In any triangle in which all angles were turned the error should be placed equally in all three angles. If a quadrilateral was used, the adjustments should be made as explained in any modern surveying text, such as Davis and Foote. After azimuths of triangulation nets are adjusted, they are usually held and azimuths of traverse lines adjusted to them. An azimuth error in a traverse line is distributed by placing an equal amount in each angle. It is found easier to use azimuths in making corrections, rather than bearings, as corrections are the same direction in all four quadrants. No correction should be made larger than the expected accuracy of measuring, considering the instrument and the number of times the angle is turned. A field check should be made if corrections are too large.

Lombert Scale Factor

For most traverses of the extent embraced by the usual highway survey, say five or 10 miles, the Lambert scale factor can be considered constant. The scale factor is a function of the latitude and can be computed by the formula found on page 59 of Special Publication No. 235 or from projection tables for the State as in Special Publication No. 202. Both of these brochures are published by the U. S. Department of Commerce, Coast and Geodetic Survey. Since Lambert coordinates are based on sea level distances, sea level factors should also be applied to measured distances. This factor can also be considered a constant for most highway surveys. For instance, application of an average constant factor for a traverse where there is a 2,000 foot difference in elevation results in a maximum error of one part in 20,000 between the high and low length. The sea level factors are given on page 59 of the Coast and Geodetic Surveys Special Publication No. 235. The sea level factor and Lambert scale factor can be combined. Corrections for pull, sag, temperature, and slope, if any, should also be made. These corrections are usually made during surveys.

An Exception

In a traverse for which the scale factor and sea level factor can be considered a constant, it is not necessary to apply the factors in making adjustments between two known points. If chaining is consistent, proration of lengths results in correct adjustment. Courses could be measured in meters or any other unit of measure and prorated to get correct results. The factors may be applied to the resultant of the traverse to determine the error of closure, or they may be applied to each length before computing the traverse.

If errors are mostly systematic, making the azimuth adjustment as mentioned, and applying a constant length factor results in an error of closure so small it may be placed in two or three lengths or two or three angles, or both. The compass rule can be applied, but this refinement is often not warranted. In any event, no angle or distance (considering the scale factors) should be changed in an amount greater than the normal accuracy of the field work.

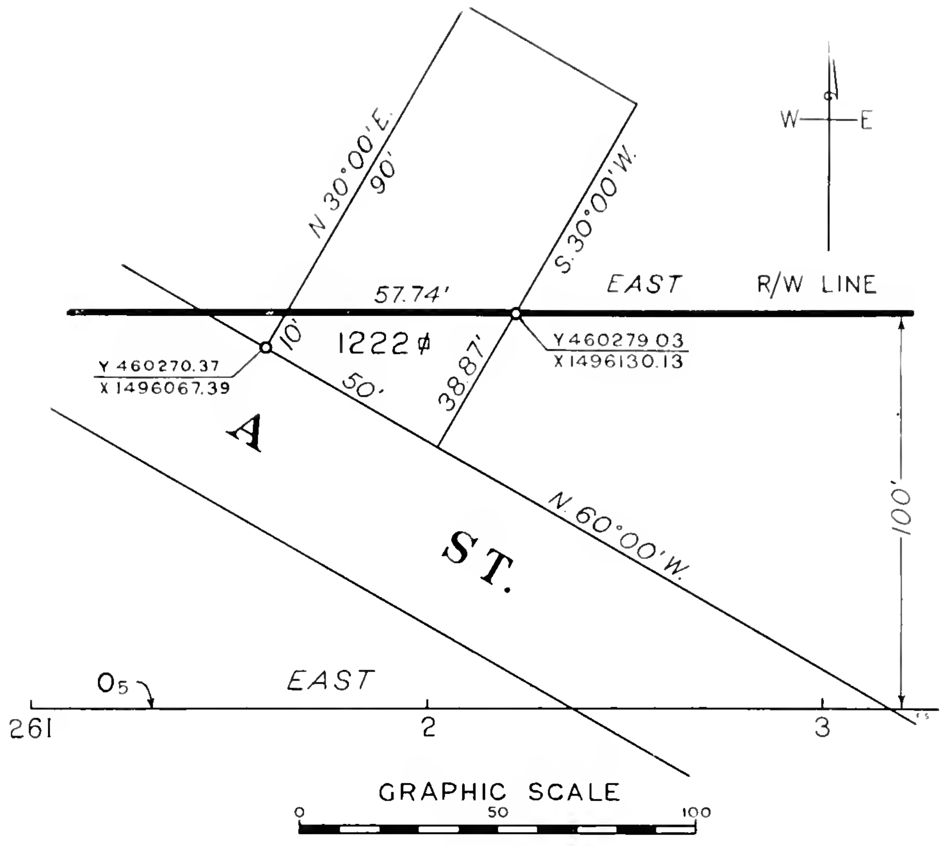


FIG. 3

Once the triangulations and traverses are adjusted, these should be held and all future office and field survey lines made to fit them. In order to keep on the Lambert grid, grid bearings and distances must always be used in calculations, maps and surveys after the preliminary lines are adjusted.

Right of Way Description

Nearly all highway improvements require acquisition of property for right of way. Before land can be acquired, it must be accurately described.

The description of a parcel of land for record purposes should positively identify the land for title purposes and should also provide the necessary information to locate the parcel on the ground. If the first condition is satisfied, it will continue to be satisfied as long as the records are kept. The second condition may be satisfied at the time of recording a deed, but in time physical monuments may decay and disappear. These stations may be restored by survey methods and these restored stations themselves become the bases from which other restorations are made. With each succeeding restoration, the accuracy is diminished as it is affected by the errors of the original survey combined with the errors of the restoration surveys. Eventually even a good survey may become little more than a paper record, beyond the power of a surveyor to establish the property lines with any degree of certainty.

The condition of providing information to locate the property on the ground can be considerably strengthened by including the coordinates on the state system of one or more of the corners of the land and by using bearings and distances based on the California Coordinate System. If the monuments which mark the land corners are destroyed, the coordinates become primary evidence of the location and the corners can be replaced by other monuments on the California Coordinate System.

In District IV, our present method of writing deeds on projects on which surveys are based on the California Coordinate System is illustrated by the following sample: *(See Figure 3.)*

Description

All that real property in the County of Alameda, State of California, described as:

A portion of that certain tract of land conveyed to John Jones by deed recorded May 17, 1945, in Volume 236, page 123, Official Records of Alameda County, said portion being described as follows:

Commencing at the most westerly corner of said tract at coordinates Y = 460,-270.37 feet and X = 1,496,067.39 feet; thence along the northwesterly line of said tract, N. 30 00′ E., 10.00 feet to a line parallel with and 100 feet northerly, at right angles, from the "05" line of the Department of Public Works' survey between Oakland and San Leandro, Road IV-Ala-69-C; thence along said parallel line, East 57.74 feet to the southeasterly line of said tract; thence along said southeasterly line S. 30 00′ W., 38.87 feet to the southwesterly line of said tract, being the northerly line of A Street, 40 feet wide; thence along last said line N. 60 00′ W., 50.00 feet to the point of commencement.

Containing 1,222 square feet, more or less.

Coordinates, bearings and distances in the above description are on the California Coordinate System, Zone 3.

Coordinates Secondary Call

The coordinates at the point of commencement are a secondary call as used above. That is, the tract corner is the point of commencement in case of a conflict with the location as established by the coordinates. This is also true if the coordinates are mentioned first, as the law specifically states that if there is a conflict between a record point and coordinates, the record point controls. However, if the corner monument is destroyed, the coordinates become primary evidence of where it stood. The coordinates may also be valuable information to surveyors, title companies, county offices, and others who plot property maps.

Before preparing deeds with descriptions as illustrated above, it is the practice in District IV to consult with officials of title companies involved and get their approval. To date, approval has always been given.

The description used above has the right of way line controlled by the survey line. The tie to the survey line controls regardless of the location of the tract. The question naturally arises: Why not use California Coordinates for control instead of the survey line which is not of record except in the offices of the State Division of Highways? This can be done by substituting the following description after the calls for the point of commencement:

. . . , N. 30 00′ E., 10.00 feet to a line with a bearing of East passing through coordinates Y = 460,279.03 feet and X = 1,496,130.13 feet; thence along last said line East, 57.74 feet to the southeasterly line. . .

This type of control should probably not be used until there is a common usage and knowledge of the California Coordinate System by surveyors and others using property descriptions.

Useless Descriptions

A large proportion of deeds now being recorded contain descriptions that are impossible to locate on the ground using the descriptions or references in the description alone. To physically locate the land with such a description it is necessary to first establish neighboring lands to establish the property lines. Some of these may have been written 50 or 75 years ago and used in each succeeding conveyance without change. As an example, the following is a description first used in a deed in 1871. It has been used in 18 deeds since, the last being in 1944. Names and dimensions have been altered without affecting its use as an example for the purposes of this article.

"All that lot of land situated in the Township of Mars, County of Venus, State of California, described as follows, to-wit:

"Beginning at a point on the northern line of the county road leading from Santa Rosa to Santa Cruz from which the southeasterly corner of a saloon once kept by John Jones bears South 88 15′ West 91 feet, 3 inches, distant; then North 0-½° East 257 feet to the center of Santa Clara Creek; thence up the center of said creek the three following courses and distances; South 38 West 138 feet; South 41½° West 100 feet South 19½° West 86 feet, 4 inches to a point from which the southeastern corner of Felix Brown's Shop bears North 20¼° West 62 feet distant; thence leaving said creek and along the northern line of said road, North 87 25′ East 180 feet, 10 inches to the place of beginning.

"Containing 58/100 (.58) of an acre and being the same land heretofore conveyed to John Jones by James Smith."

From this description, it would be practically impossible to reproduce the boundaries of this parcel as John Jones' saloon and Felix Brown's shop are long since gone and the other landmarks mentioned probably altered. A tie to the coordinate system would make reproduction much more certain.

This indicates clearly the need for better physical ties for land descriptions. The use of coordinates in deeds based on the California Coordinate System seems to satisfy this need.

Appreciation

The authors wish to express their appreciation for the guidance and assistance given them during preparation of this article by Mr. T. E. Ferneau, Assistant District Engineer. The work is being done under the direction of L. A. Weymouth, District Engineer, and Jno. H. Skeggs, Assistant State Highway Engineer.

To any interested person desiring to study the more technical aspects of coordinate systems, the following publications of the U. S. Department of Commerce, Coast and Geodetic Survey, are recommended:

Special Publication No. 193—Manual of Plane-Coordinate Computation.

Special Publication No. 194—Manual of Traverse Computation on the Lambert Grid.

Special Publication No. 195—Manual of Traverse Computation, Mercator Grid.

Special Publication No. 202—First and Second Order Triangulation in California.

Special Publication No. 235—The State Coordinate Systems.

FROM A HIGHWAY

At sunrise and at sunset
I see the world in silhouette;
The tangled branches of the trees
Are etched in mystic harmonies.

The fir trees and the placid palms
Enfold the shadows in their arms,
While rose and orange, blue and
green
Are intermingled in the scene.

The mountains modify the line
That tells the earth of heaven-shine—
Both opening and closing day
With bugle notes of sunlight-play.

JOHN WARWICK DANIEL III
Delineator,
Design Department
Highway Division,
Los Angeles

Uniformity *of Class "C" Cement-Treated Base Subject of Tests*

By W. R. LOVERING, Senior Highway Engineer

The addition of small amounts of cement to imported base materials to reduce plasticity and increase the supporting power of the base is being more and more generally used on California highways. This type of construction, now designated as Class "C" cement-treated base, is particularly adaptable to roads with low traffic density but heavy axle loadings, which is characteristic of roads used for log hauling. Under this type of traffic, heavy construction is generally not warranted and yet the average crushed gravel base will not adequately support the heavy wheel loads without excessive thicknesses of surfacing.

This type of construction has been used extensively in other parts of the State. District I has several routes, however, which carry relatively light traffic volumes but on which approximately 15 percent of the traffic consists of heavy logging trucks. On these routes Class "C" cement-treated base provides an inexpensive but apparently satisfactory foundation.

Aggregate Unsatisfactory

Most of the aggregate used in this district comes from river bars and, even when crushed, is not satisfactory for heavy wheel loadings without the addition of Portland cement.

The Class "C" cement-treated bases have been constructed by mixing approximately 2 percent of cement with the crushed river gravel by road mixing methods, either with a blade or a road mixing machine. As the cement content is very low, there has been widespread doubt as to the uniformity with which the cement could be distributed.

In order to secure information on the uniformity of mix obtained by blade mixing, a large number of compressive strength specimens were tested on the Maple Creek project in Mendocino County, road I-Men-48-A. The investigation was carried on as a part of the normal control testing with specimens being compacted in the field by Street Inspector R. J. Datel, and broken in the district laboratory by N. R. Price.

Construction Procedure

The imported base material, consisting of crushed gravel from Rancheria Creek, was placed on the roadbed in a windrow of sufficient size to provide a three-inch compacted course. This was as large a windrow as could be handled conveniently on the roadway without preventing the movement of traffic, and no attempt was made to mix the full six-inch depth at one time.

The Portland cement was spread on the windrow by hand-dumping the sacked cement. Each windrow was from 600 to 1,100 feet long. Mixing was accomplished with two motor patrols working in tandem. The windrow was turned four times for the dry mixing and four times after the water was added, but, because of the size of the windrow, several trips of the motor

This equipment is dry mixing cement and gravel during successful tests in Highway District I

patrols were required for one complete turning. Mixing was continued until a mix of uniform appearance was obtained. Approximately six hours were required for the complete mixing operation.

After a uniform mix was obtained, the material was spread on the roadbed and compacted in approximately one hour with two rollers. The material compacted nicely and made a satisfactory appearing base, with the exception of one day's mixing, November 2, 1949, in which the moisture content was somewhat high.

Testing Procedure

Standard cement-treated base compressive strength test specimens were compacted from the mix as soon as mixing was completed. Usually three specimens were obtained from each completed windrow. As approximately 15 minutes were required for the compaction of each test specimen, 45 minutes had usually elapsed before the third of these specimens could be compacted. A record was kept of each specimen showing the time interval to check on the possibility of this factor introducing an additional variable into the test data. However, there appears to be no consistent difference between specimens compacted within 15 minutes and those requiring 45 minutes. This may be because of the extremely long mixing time required for the blade mixing.

After the specimens were fabricated, they were shipped to Eureka and compressive strength tests were made at the end of 28 days. It was expected that the compressive strength test results would be quite low because of the low cement content, and it was felt that seven-day testing might lead to fracture of the specimen during the preparation for testing. The breaks were quite high, however, considering the low cement content and the long interval of time between adding the cement and completion of mixing.

Test Data

Twenty-eight day compressive strengths obtained on the 2 percent cement-treated base mix range from 442 psi to 845 psi with a mode, or most possible value, of 576 psi. It is interesting to note that the maximum and minimum results were both obtained on the same day, but not from the same windrow.

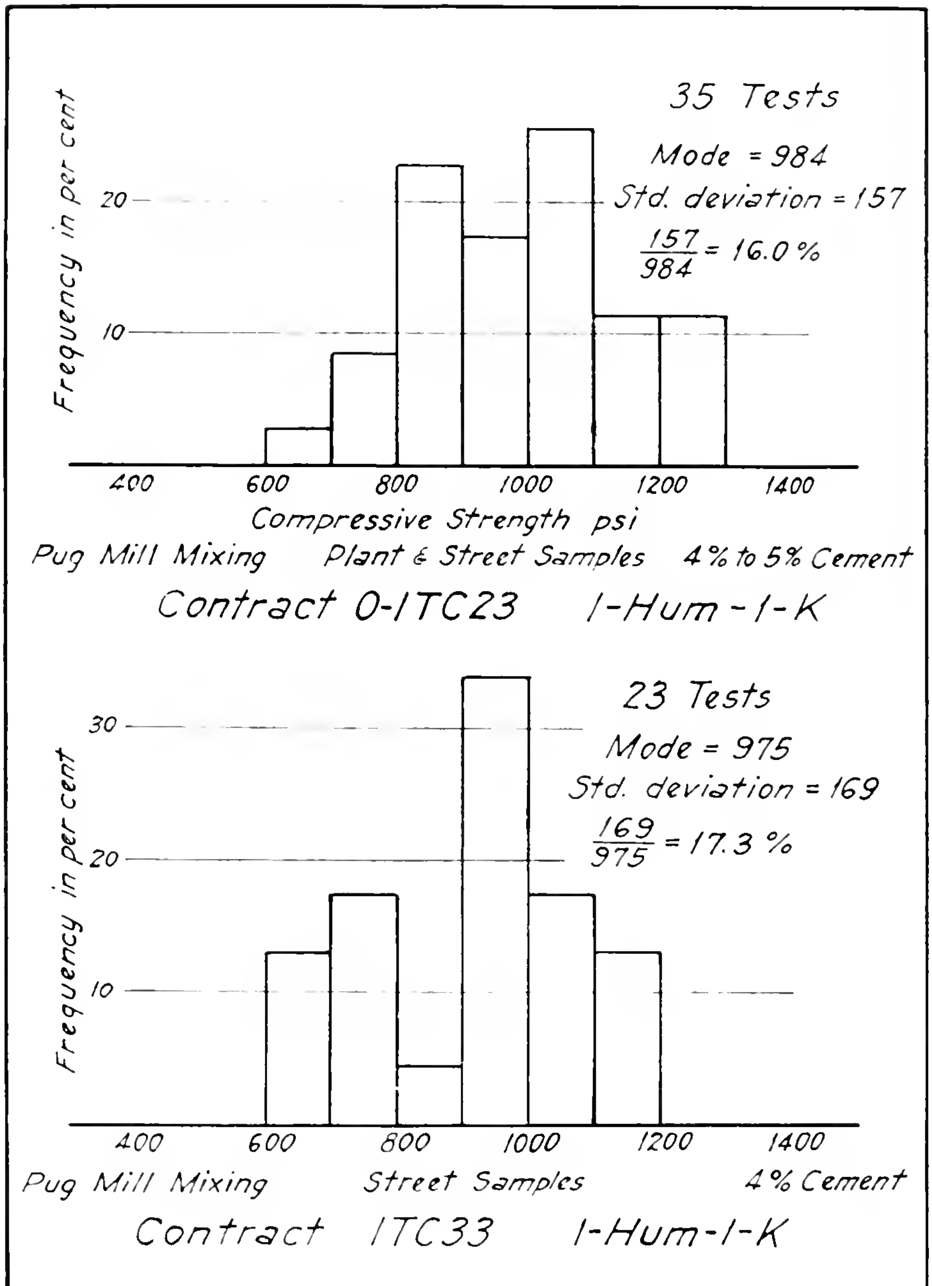


Fig. I

In order to provide a measure by which these results may be judged in relation to those obtained on our standard cement-treated base mixtures, frequency distribution of the test results are shown graphically on the prints, *Figure 1 and Figure 2*, both for this project and for three other typical plant-mixed cement-treated base jobs. Two of these projects, Contracts O-1TC23 and 1TC33, were constructed of gravel from Redwood Creek near Orick in Humboldt County. The other, Contract 1-1TC34, was built with gravel from the Klamath River at Klamath, in Del Norte County.

These graphs show that a better grouping of test values was obtained on the Class "C" mix than on the Class "A" mix; however, the breaks are considerably higher on the Class "A" mix and a greater spread of values is to be expected.

The data were subjected to statistical analysis and in order to get a more accurate measure of dispersion, the standard deviation was calculated for each project and the value obtained was divided by the mode. This value, the "coefficient of variation" which makes proper allowance for the higher breaks obtained on the Class "A" mix, should be a reliable indication of the uniformity of the test results.

The value of 18.9 percent obtained on the Class "C" cement-treated base is slightly higher than the values of 16.0 percent and 17.3 percent obtained on the two Redwood Creek projects, indicating slightly poorer uniformity, but is considerably better than the value of 23.5 percent obtained for the Klamath River project.

The extremely long mixing times used on the Class "C" mix are probably not typical of the average run of jobs, and either a reduction in the mixing time or an increase in the cost may be expected in future projects.

It should be noted that the aggregate used on this project was a crushed gravel with a relatively low dust content as shown by the attached grading chart. This study did not cover the use of finer materials and no implication is intended that similar results will be obtained with all types of aggregates.

Conclusions

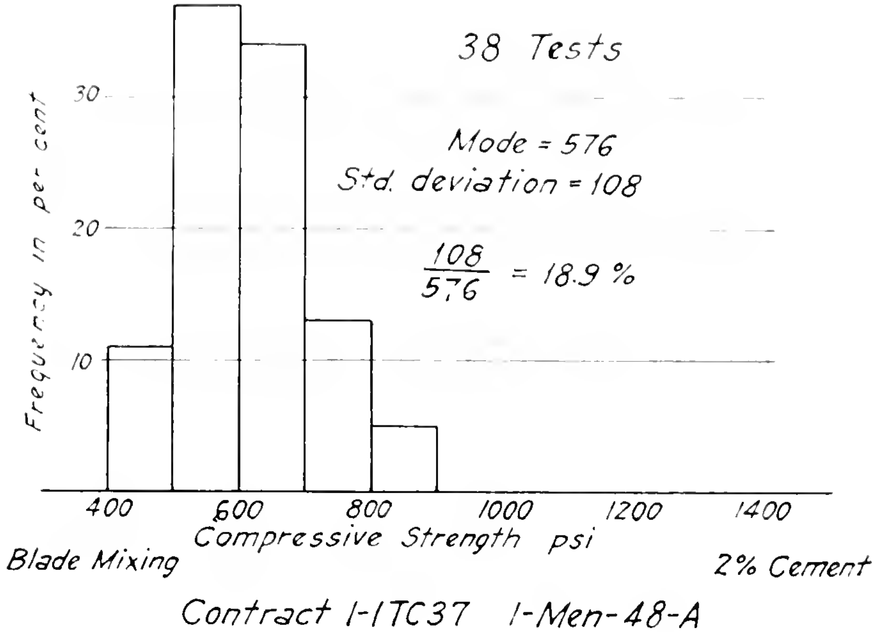
1. The uniformity of mix obtained on Class "C" cement-treated base using crushed stream gravel and mixed with blades on Contract 1-1TC37, road I-Men-48-A (Figure III), compores favorably with that obtained on our plant-mixed Class "A" cement-treated base.

2. Compressive strength values are sufficiently high to justify continued use of this class of base on roads of lower traffic density or as a subbase on the more heavily traveled routes.

3. Additional ottention should be given to the improvement of the uniformity of the plant-mixed product.

PATIENCE PAYS OFF

Patience pays off when you are caught in congested traffic lanes. By waiting your turn to move ahead, you do other motorists a favor and avoid trouble yourself.



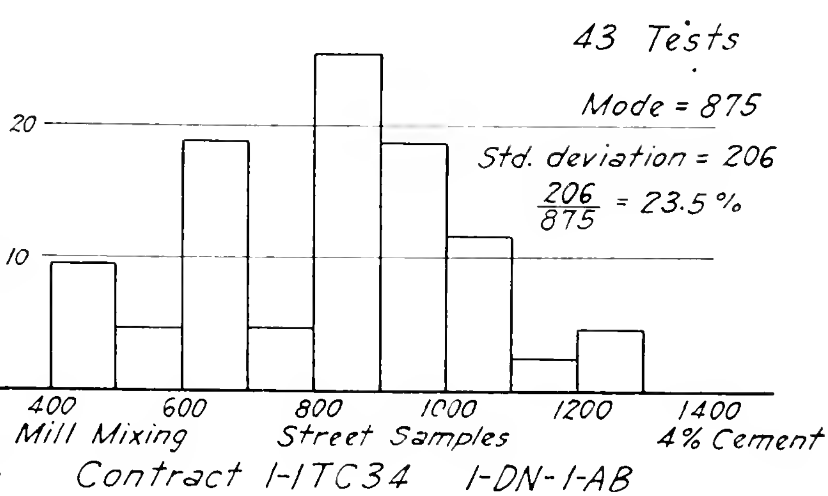


Fig. II

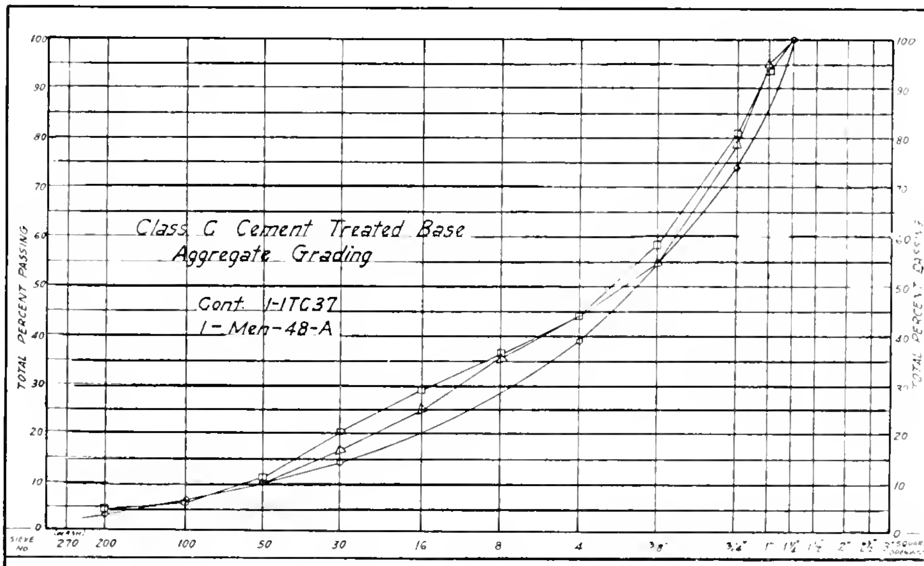


Fig. III

Modern Containers

Service & Supply Department Effects Saving of Highway Money

By G. G. McGINNESS, Assistant Engineer, Service & Supply

WHENEVER Portland cement concrete is poured in a pavement or fairly large structure on a state highway, samples of the concrete are taken at specified intervals. Samples are also taken from concrete buildings constructed for the State under the supervision of the Division of Architecture. These samples or specimens are carefully fabricated in tinned cans six inches in diameter and 12 inches high by a method simulating the placing in pavement or structure. They are allowed to cure for a short time and then they are shipped to the Materials and Research Laboratory in Sacramento where they are tested for strength.

G. G. McGINNESS

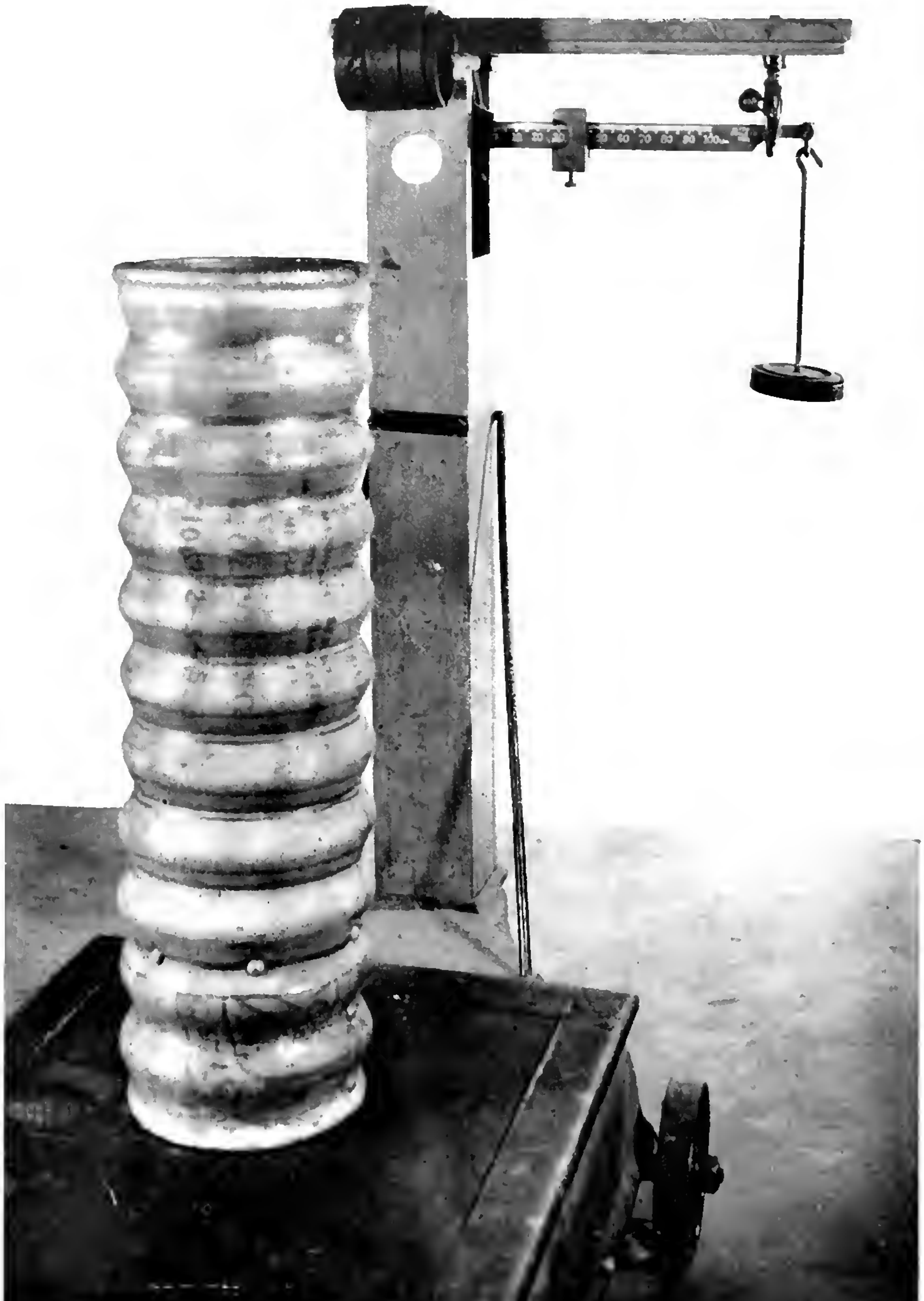
For many years these specimens were shipped from the job to the laboratory in containers made of 16 gauge eight inch corrugated metal pipe. Specimens were packed in wet excelsior, two to the container, making a gross shipping weight of 82 pounds. These were shipped by railway express as no other common carrier would guarantee the necessary prompt delivery. After the specimens were unpacked, the containers were returned to the job by express.

Shipment Costs Decreased

Analysis has shown that almost 1,800 concrete sample shipments were made by the Division of Highways during the year 1949 at a cost of approximately $6,500.

The Service & Supply Department of the Division of Highways in its role of investigators of service became aware of the high cost of these metal shipping containers and the added shipping charges due to their weight and decided to see if there was not a lighter

Empty metal shipping container on scale. Note weight is almost 30 pounds



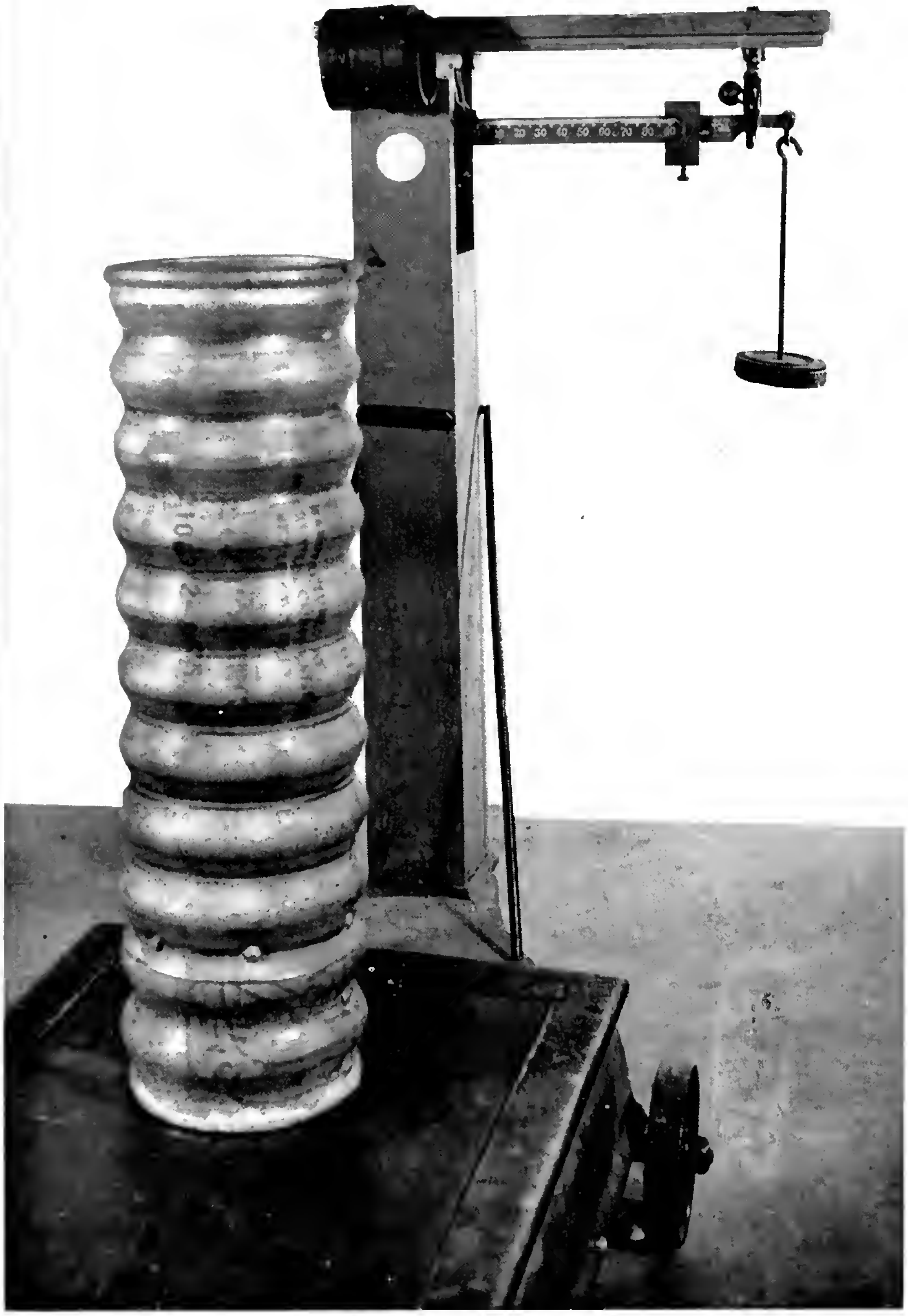
shipping container which would serve the purpose.

In cooperation with the Materials and Research Department, and a carton manufacturer, the Service & Supply Department distributed several corrugated paper containers designed for two concrete specimen cylinders. The cylinders shipped from the field in these cartons, which have a gross weight of less than 60 pounds, were received at the laboratory in Sacramento in excellent condition.

Considerable Saving

An analysis of comparable express shipping costs on the shipments made during the year of 1949 by the Division of Highways, indicates that a saving of over $1,700 per year may be expected by using the lightweight cartons in lieu of the metal shipping containers. Savings on individual shipments will range from $0.48 to $1.68 with an average saving of a little less than $1 per shipment. The saving of the difference in the first cost of the containers is in addition.

Metal shipping container with two concrete specimens. Weight over 80 pounds



Further savings in transportation costs are also being made by shipping by means of truck freight whenever facilities insure prompt delivery. This applies not only to the concrete samples but many other samples of construction materials which must be sent to the laboratory by the engineer in the field. For example, 12 sacks of sample aggregate weighing 435 pounds can be shipped from Bakersfield to Sacramento in one day by common carrier truck, door to door delivery, for $4.87. The same shipment by express would cost $16.53. Care in the selection of transportation agencies in such cases throughout the State will result in a saving of approximately $10,000 yearly.

Although the metal shipping containers were used many times and the carton only for one shipment of concrete specimens, the saving in shipping charges more than pays for the carton on the shortest shipments.

Besides being used to ship the concrete specimens from the field to the laboratory, these cartons are used to ship the empty tinned cans from the Service & Supply Department warehouses to the engineers in the field. When the engineer in the field receives the carton, it contains not only the empty cans but complete instructions for use, illustrated instructions for proper packing, the necessary pieces of gummed tape to seal the carton securely and also two labels addressed to the Materials and Research Department Laboratory in Sacramento.

In addition to carrying the empty cans to the field and the specimens to the laboratory, many of the used cartons are being salvaged and reused for packaging miscellaneous materials.

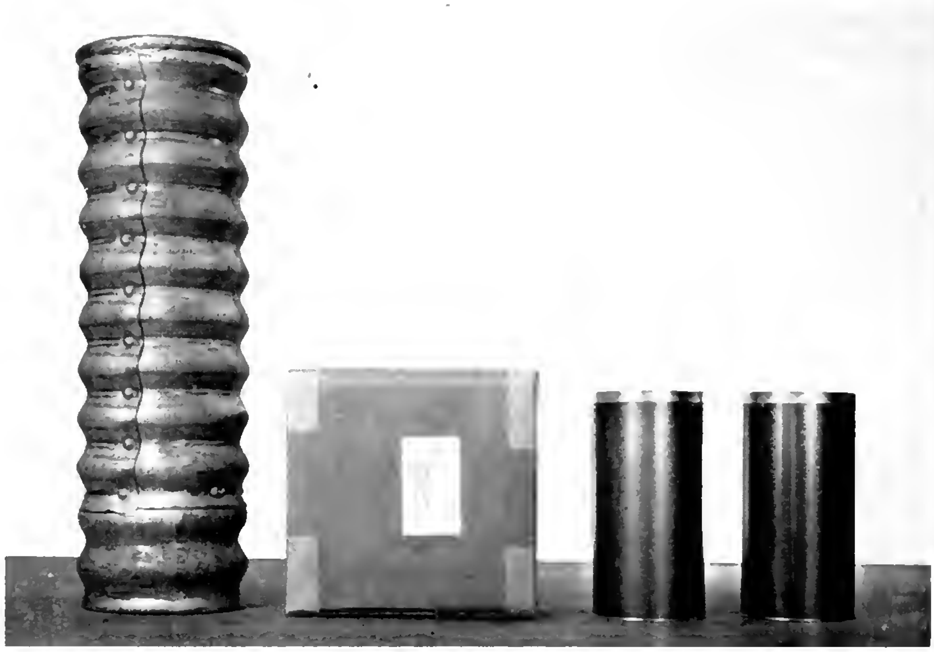
By asking "*why*" the metal shipping containers were necessary, the Service & Supply Department has been able to save on the first cost of the containers, on shipping charges, in time and convenience to the engineers in the field, in time of clerks consigning empty

containers back to the job, and the salvage of the used cartons for other purposes.

The specifications used for procurement of these cartons are printed below.

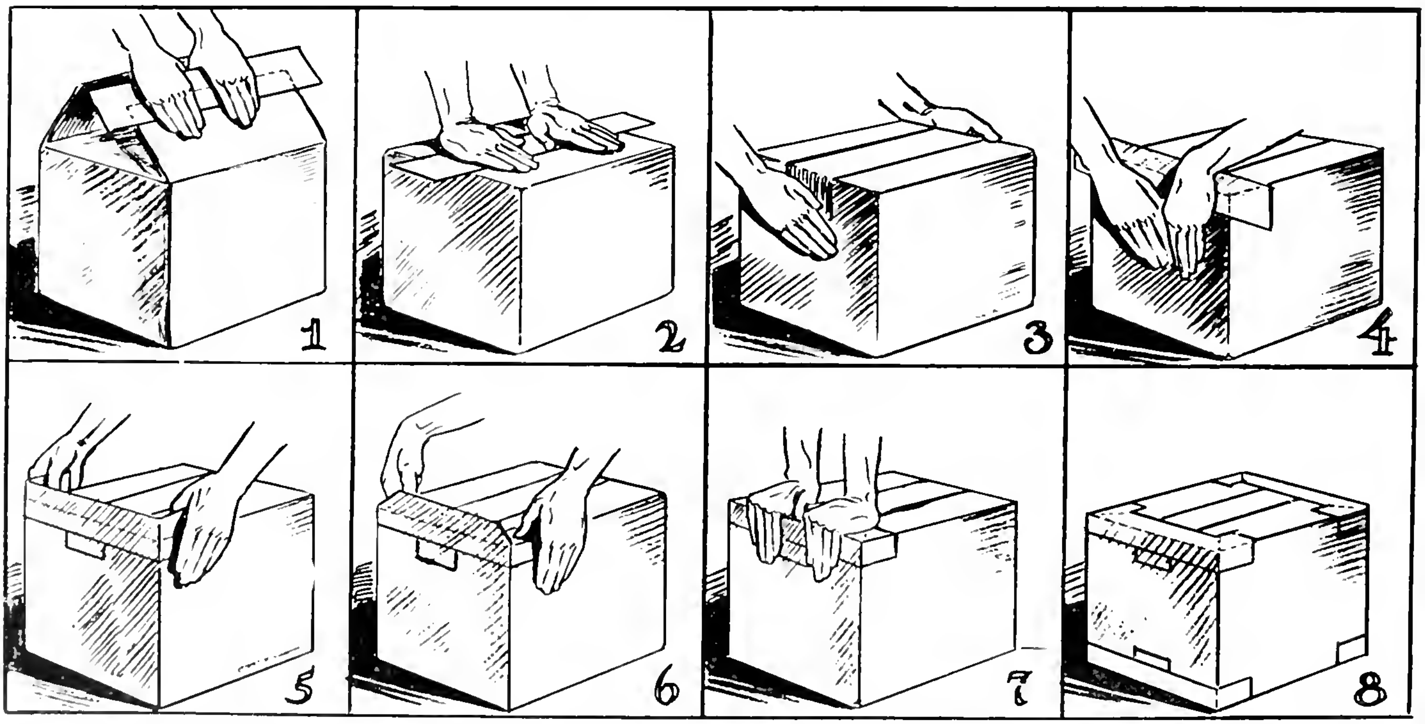
California Division of Highways Specifications for Corrugated Paper Containers for Shipping Concrete Specimens

(a) Size of Container. The inside dimensions of the container shall be such that it will snugly hold two metal concrete specimen cans six inches in diameter by 12 inches high, separated by a quarter-inch thick pad. The height shall be sufficient to fold the top down without bursting a two inch strip of 60 pound gummed kraft paper tape in shipment. The approximate inside dimensions shall be 12¼ inches wide, six inches thick and 12¼ inches deep.



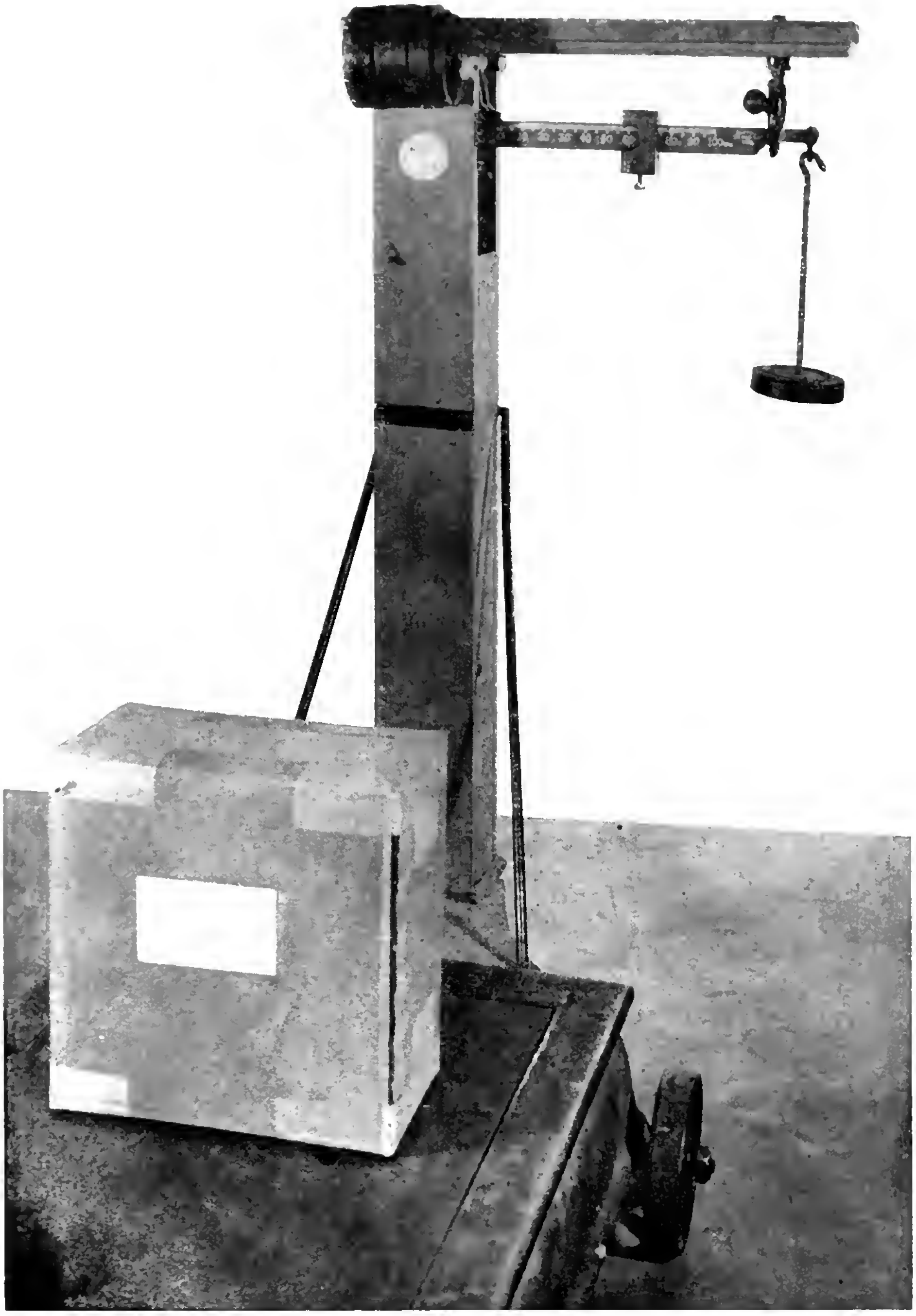
This illustration compares metal and corrugated paper containers and shows sample cans which they are designed to carry

How to Apply Gummed Sealing Tape Properly



1- Apply strip of tape to one flap. Allow at least a 3-inch overlap.
2- Close flaps and seal center seam. Press firmly with heel of hand.
3- Fold down end overlap. Press downward firmly with palms.
4- Seal edge seams with at least a 3-inch overlap at each corner.
5- Bend around sides and pull tightly around carton, pressing inward.
6- Fold corners over top and press firmly with thumbs.
7- Fold and press top to complete sealing of the edge seams.
8- The finished job, securely sealed on all seams, top and bottom.

Always use the correct basis weight and width for your particular job. Remember, to double-strip your carton -- is waste.



The new corrugated paper container with two concrete specimens. Note that weight is less than 60 pounds

(b) Size of Pad. The pad shall be twelve inches (12″) by six inches (6″).

(c) Material. The material of both pad and container shall be double wall corrugated kraft or jute paper to conform to the following requirements:

350 pounds per square inch bursting strength.

100 square inch size limit.

120 pound gross weight limit.

(d) Construction. Jointing of one side only will be accomplished by the use of at least a one and one-quarter inch ($1\frac{1}{4}''$) overlap on one panel and flat wire stitching to the adjacent panel.

The container shall conform to all construction requirements of Consolidated Freight Classification Rule 41.

In Memoriam

WILLIAM HARTMAN PETERSEN

William Hartman Petersen, Principal Structural Engineer, Division of Architecture, died suddenly on November 11, 1950. He was a native of Watsonville, Santa Cruz County, California. He was born September 28, 1897. His early life was spent in this area and he attended grammar school at Castroville. His parents, Peter and Agaptha Petersen, were natives of Denmark who moved to California where they took up farming and eventually purchased a large ranch on U. S. Highway 101 about five miles south of Salinas, California.

Like many farm boys, Mr. Petersen decided he would rather be a civil engineer than an agriculturist, so he enrolled in the Polytechnic College of Engineering in Oakland and completed his training about 1917.

His first engineering position was with the Pacific Gas and Electric Company. However, the work on this project was terminated suddenly by World War I. His employment record shows that the next few years were spent working for the California Highway Department and the Nevada Highway Commission. On February 4, 1926, he accepted a position as Junior Structural Engineer with the Division of Architecture and his employment has been continuous since that date except for a short period during World War II.

During his service he was always active and interested in the welfare of his fellow employees. At the time of his death he was president of the Central California Structural Engineers' Association as well as a delegate to the State Employees Association.

Mr. Petersen was well thought of by his fellow workers and his sudden death due to a heart attack on the afternoon of November 11, 1950, came as a shock to his family and his many friends. He is survived by his wife, Mrs. Beryl Wilson Petersen, and two children, Marcia Ann, and Andrew Hartman Petersen, and also by two brothers and a sister.

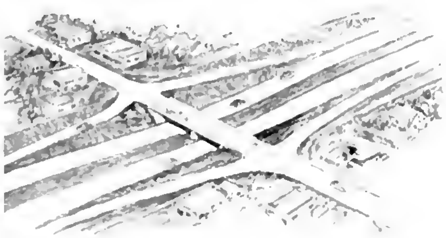
Traffic Interchange Design

By SAM HELWER, Assistant Engineer of Design

This is the second of three articles by Mr. Helwer—Editor.

DIAMOND TYPE

ANOTHER type of design which has been used extensively is the diamond type. This rather simple looking design has a great deal in its favor, due principally to this simplicity. It requires a minimum number of connections, is direct in alignment and can be compressed into an area that would not accommodate any other design type. Consequently, it is well suited to heavily developed area. It is easily signed and requires a minimum of circuity of travel.



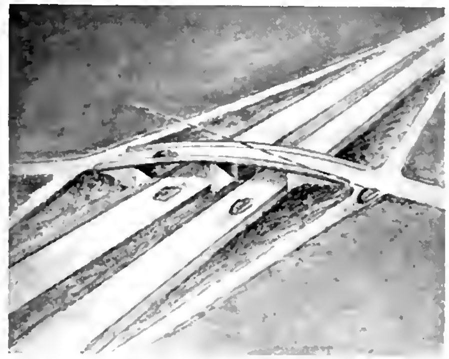
Diamond type design

There are some disadvantages, however, which must be considered. While all four of the right-turn movements can turn right and merge without crossing conflicts, all four of the left-turn movements are required to turn left across traffic on the cross street. Another disadvantage, under certain arrangements of grade lines, is an inadequacy of sight distance at the ramp connections to the cross street.

Diamond Type Grade Line Systems

The most desirable grade line arrangement for a diamond type interchange is one in which the freeway is completely in cut section at the intersection. This arrangement requires a minimum amount of disturbance to the existing street system and provides better sight distance conditions at the ramp intersections with the cross street. The advantage of not requiring revision of the grade lines of the existing street system is very desirable in highly developed areas where a change in grade would necessitate outright acquisition of many affected properties.

Another grade line system which requires no change in grades of the existing street system is one in which the freeway is on a structure over the cross street. While this design also leaves intact the properties fronting on the local street, it has the disadvantage of reduced sight distance at the ramp intersections with the cross street. In this arrangement, the horizontal sight distance on the ramps is impaired by the freeway fill. While this condition can be helped by moving the connections laterally to a position farther removed from the separation structure, some of the inherent advantage of the diamond type is lost by increasing the right of way required.



Better sight distance

The least desirable grade system for a diamond type interchange is one which requires a complete raising or lowering of the local cross street. This system not only may require acquisition of the properties fronting on the cross street for a distance of about 600 feet on each side of the freeway, but also creates undesirable sight distance restrictions at the ramp connections to the cross street.

Diamond type off-ramp with freeway on fill

The vertical sight distance provided on the cross facility is usually not in excess of 35 miles per hour nonpassing sight distance. On a crest vertical curve, this lower sight distance, combined with the additional sight restrictions imposed by the bridge railing on the separation structure, creates an unfavorable ramp intersection which may be hazardous under certain traffic conditions. Although modern bridge railings are open and well designed for a maximum of sight distance, there are always conditions where any railing has the same effect as a solid obstruction to a driver stopped on a ramp just opposite the end of the structure. For these reasons, great care must be exercised to obtain the best sight distance possible under the design controls imposed on the interchange designer.

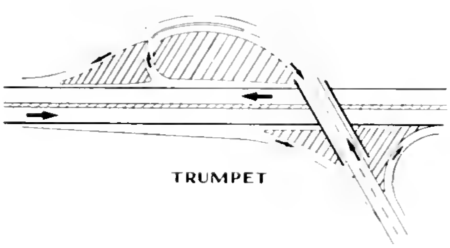
BRIDGED ROTARY

The bridged rotary type interchange, although capable of moving large volumes of traffic, has not been used extensively in California. This design requires two separation structures and large right of way areas to provide for the design of a traffic circle which will permit adequate turning radii and weaving lane sections. The need for large areas makes this design unsuitable in highly developed areas which is a usual condition in California.

The two separation structures permit uninterrupted flow of the through movements on the freeway, but the through traffic on the cross facility and all the left and right turning movements must weave or merge on the traffic circle at grade.

TRUMPET TYPE

The trumpet type interchange is used at "T" intersections, which require provision for only six traffic movements instead of the customary 12 movements of a full intersection. Of these six movements, two are straight through, two are right turns, and two are left turns. Turning movements at "T" intersections are usually heavier on one side of the trumpet than the other, which permits a design that subordinates the minor movements to the major flows of traffic. The trumpet is inclined to provide direct high standard alignment for the major movement, while the minor movement is required to go through an indirect cloverleaf movement on a lower standard of design.



End view of bridge railing which obstructs view of vehicle approaching on crest vertical, top of which shows just above bridge railing

At "T" locations where the interchange movements are all relatively heavy and of equal importance, a multiple structure interchange may be warranted to provide more direct alignment for all movements. The "San Francisco Airport Overcrossing Interchange" on the Bayshore Freeway is an example of this type of "T" intersection interchange.

COMPARISON OF INTERCHANGE TYPES

In addition to the preceding interchange types, there are hybrid combinations, too numerous for individual discussion. They usually represent difficult physical controls and unusual traffic patterns and for these reasons are the most difficult to design.

It would again be convenient to have definite design and traffic warrants which would enable the designer immediately to select a diamond type, for example, in preference to a cloverleaf type. Unfortunately, this cannot yet be done; each interchange location must be individually analyzed on the basis of traffic service and cost.

Right of way and construction costs can be determined with a relatively high degree of accuracy, but much research remains to be done before traffic service can be evaluated to the same degree of accuracy.

The following comparison of right of way areas that have been acquired for the interchange connections for several interchanges on completed projects is of interest. The areas indicated are for ramps and loops only, and are exclusive of the normal right of way for the freeway proper.

Interchange	Type	Loop radius	Additional ramp area, acres
San Bruno Ave.	4-quadrant cloverleaf	130′	14.4
Pierce Road	Bridged rotary	130′	8.9
Swanston Road	2-quadrant cloverleaf	55′	4.1
Santa Clara Ave.	Diamond		4.0

If the required interchange areas are highly developed with correspondingly high land values, the advantages or disadvantages of a particular design type from the standpoint of initial cost are readily apparent. Large areas not only increase initial cost, but also increase perpetual maintenance cost. The removal of large areas of productive land or valuable developed properties from the tax rolls should be

avoided if alternative designs giving comparable traffic service are possible. Where right of way costs will be a major factor in a cost comparison analysis, the Right of Way Department should be requested to make the cost estimate of the affected parcels.

INTERCHANGE STRUCTURES

Up to this point, this discussion has treated the interchange structures as an item to be taken for granted because obviously if an interchange is to be constructed, it is necessary to have a bridge. The interchange designer, however, cannot take structures for granted; he must always give structure requirements a top priority in his thinking from the standpoint of both economy and operating characteristics. Frequently the interchange structure is the most important single item in the project.

The interchange designer must be thoroughly familiar with the effect that horizontal and vertical curvature, superelevation, skew angle and span length have on the over-all cost and appearance of the structure. While the bridge engineer will make the ultimate decisions on the structure, there are several broad rules which will expedite design if they are recognized at the beginning of preliminary interchange studies.

1. Span Lengths

The economic relation between materials of construction, methods of fabrication, type of structure and span length follows definite patterns. Of course, there are variations and overlapping, but it can be assumed for the average job that the material and type of construction for given span lengths will be as described below.

Pierce Road rotary separation structure north of Bakersfield in Kern County

A. For short low spans from 16 to 40 feet long, reinforced concrete slab spans have been proving more economical. This type bridge has the further advantage of being less than 2½ feet thick, cutting cost of approach fills and increasing vertical sight distance.

B. When spans are from 35 to 75 feet long and bents are of medium height, the choice usually lies between rolled steel beams and concrete "T" beams. Comparative availability of materials and labor and foundation conditions will effect the economy of this group. The steel beam spans require only four feet of depth; the longer concrete beams will exceed this.

C. When spans range from 60 to 125 feet long, the economical choice lies between reinforced concrete boxed girders and riveted steel plate girders. Foundation material, loads, curvature, superelevation and skew are factors affecting economy of these two types. Steel structures are preferable for poor foundation conditions due to their lighter weight and adaptability for articulation, and also for heavier railroad loadings. Concrete structures are more adaptable to curved, skewed and warped alignment and present the best appearance for one, two or three span highway separation structures.

In rural areas where pedestrian travel is light and appearance is not a major factor, an open-end, multiple-span structure bridge is usually more economical than a high abutment type. The open-end structures, however, should be avoided in congested areas especially if accessible to pedestrians.

2. Horizontal and Vertical Curvature

The interchange layout should avoid variable superelevation on the structure wherever possible. The structure should either be completely on curved alignment, or on tangent alignment a sufficient distance from the beginning or end of a horizontal curve to be beyond the influence of superelevation.

From an appearance standpoint, the structure is usually the center of interest in the layout. Roller coaster grade lines are not pleasing in appearance, particularly on the bridge rails. From the standpoint of economy, roller coaster grade lines are difficult and

expensive to design and construct. It is realized that the structure is usually the point of critical clearance, but unless some natural topographical feature governs the grade line, reverses of grade on the structure should be avoided.

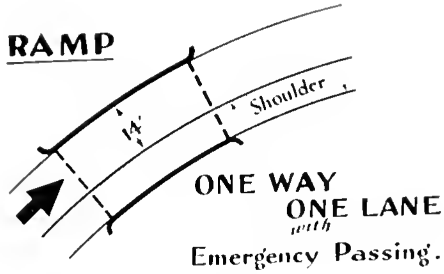
In the preliminary interchange studies, adequate vertical clearance should be provided for the required span lengths. If the structure thickness is less than contemplated in the preliminary design, it will be noted on the preliminary bridge studies, and the grade lines can be revised if economy or increased sight distance warrants the change.

3. Structure Widths

From the standpoint of traffic service and safety, the most important design feature of the structure probably is its width. Due to the high speed of traffic and large size of commercial vehicles, it is extremely important to provide full unobstructed shoulder widths across the structure wherever possible. Structures narrower than this width not only introduce taffic hazards but also reduce traffic capacity. A vehicle stalled in a traffic lane, because of the lack of an emergency parking shoulder, reduces the capacity of the facility by more than one lane of traffic due to the hazard and conflict introduced into the other lanes.

In California freeway practice, all bridges having a length less than 100 feet are built with full shoulder width. Although it would be desirable to provide emergency parking shoulders for the full length of all structures, economy forces a reduction of width on the longer structures. Structures over 100 feet in length are designed to a width four feet wider than the traveled way. This extra four feet provides a two-foot offset to the bridge curbs on each side of the traveled way.

One exception to this rule is for structures on one-way, one-lane ramps. For these ramps, the minimum structure width provides room for emergency passing of a stalled vehicle in all cases. Failure to provide this width could result in complete blocking of a ramp by a single stalled vehicle.



4. Horizontal and Vertical Clearance

Horizontal clearances to a bridge abutment or pier depend on whether the obstruction is to the right or left of traffic. On the driver's left, the *minimum* clearance is 4½ feet from the pavement edge. The recently adopted 16-foot minimum freeway median results in 4½-foot clearance from the curb line or 6½ feet from the edge of pavement. On the right side the minimum clearance is increased to six feet, but preferably eight feet, based on the belief that a driver will shy farther away from an obstruction on his far side.

Vertical clearance to a structure over a traffic lane is 15 feet, which is 1½ feet in excess of the legal load height limit. Vertical clearance over a railroad track is 23½ feet.

RAMP CONNECTIONS AND SPEED CHANGE LANES

The safe and efficient functioning of any traffic interchange is directly dependent on the auxiliary lanes and ramp connections which transfer the interchange traffic from one facility to the cross facility. Ususally this transfer is between a high-speed, free-flowing freeway and a lower design standard local street or road. In order to maintain the free-flowing characteristics of the freeway, the ramps and auxiliary lanes at their junctions with the freeway must be designed to comparable high design standards. However, at the junction to the local facility, it is frequently necessary to reduce ramp design standards to conform to local street design standards, local traffic regulations and for consideration of pedestrians.

Speed Change Lanes

The speed change lanes on a freeway provide auxiliary areas for the deceleration of leaving traffic and the acceleration of entering traffic. The length of a deceleration lane is based on leaving the freeway at 0.7 of its design speed and decelerating to the safe speed of the ramp alignment. The length of an acceleration lane is based on the distance required to accelerate to 0.7 of the design speed of the freeway from the safe speed of the ramp. The use of the 0.7 design factor is an American Association of State Highway Officials recommendation, based on observations of average speeds on freeway lanes. Similar observations in California indicate this figure may be somewhat low for drivers on California freeways.

In the design of speed change lengths, a word of caution appears desirable. It must be understood that present design standards do not include a safety factor for speeds higher than 0.7 of the freeway design speed. They assume that decelerating traffic can always get off the freeway, that accelerating traffic can always enter, and that the driver will drive at the assumed design speed of the ramp alignment. These assumptions may cause operating difficulties when the traffic volumes on our newly constructed facilities exceed the practical capacities for which they were designed.

(To be continued)

In Memoriam

SAMUEL J. SMITH

Samuel J. Smith, resident engineer for District VIII of the State Division of Highways, died Monday in Sawtelle Veterans Hospital after a brief illness, it wos learned yesterday.

Mr. Smith, 32, who resided at 1259 Genevieve Street, San Bernardino, had been an engineer in the Division of Highways in San Bernardino since 1941. He served with the 956th Engineers Topographical Company during World War II.

He is survived by his parents, Mr. and Mrs. Harry C. Smith, and two sisters, Mrs. Leah Smith and Mrs. Mary Morgan, all of Los Angeles.

Successful Test

Road Mixing Machine Proves Satisfactory in District I

By R. L. MYERS, Resident Engineer

The P and H "Single-Pass" Soil Stabilizer was used for the first time on a state highway project during the summer of 1950 near Orick, Humboldt County, in District I. It was used for road mixing into cement-treated base a graded aggregate which had been placed on the roadway to the required depth and section. The over-all results were considered very satisfactory.

It appears that this machine is particularly adapted to mixing base material that has been recently placed and sufficiently compacted to provide a good riding surface for traffic. This base should be constructed closely to section as it is our opinion that the final riding qualities, lack of sags and uniform crown or super elevation in the completed base is controlled largely by this prior preparation of the base to be mixed.

P & H Stabilizer processing cement stabilized base on U. S. 101 near Orick

Controls Material Volume

The construction of this machine is such that all the material to be mixed is lifted cleanly off the roadway and no material below the lower plane of the proposed mixture is disturbed. This prevents areas of loose or uncompacted material below the cement treated base and provides an excellent control of the volume of material to be mixed. The depth control for the thickness of base appears positive.

The machine may be operated at any of several speeds ranging from 6.2 to 32.9 feet per minute while mixing. The mixing action is apparently as thorough at the maximum rate of speed as at the minimum. However, one criticism of the machine was made by the operator who felt that it was difficult to steer the machine to a true line at maximum mixing speed. It would be well to note that this operator had never operated a machine of this type before and the alignment of the road in this case presented numerous sharp curves with radii as short as 400 feet and no longer than 500 feet.

Operation of Machine

The machine is steered much in the same manner as a caterpillar tractor. The mixing chamber is supported on a transverse member immediately behind the rear end of the tracks on which the machine travels and protrudes about 10 feet to the rear. Any small change in the direction of the machine is greatly amplified in the sidewise movement of the mixing chamber. This, of course, can be controlled by careful operation of the machine and anticipation of turning movements by the operator.

The arrangement of this machine is such that a water truck is pushed ahead and water is pumped through tanks within the machine to the mixing chamber. One good point is that the machine can operate for some time on the water in its own tanks while water trucks are being changed or filled.

Driver Must Be Skilled

One disadvantage is that the water truck obscures the operator's view when moving around a curve to the right. The operator sits over the left track sighting over a butterfly sight mounted immediately in front at a vertical needle mounted on the left side of the radiator. He aligns these sights with line rods from three to six feet long set one foot inside the edge of the area to be mixed and for 200 feet ahead. Obviously, a water truck would interrupt the view on sharp curves. The application of water is precisely controlled through a registering meter and is applied through one or two spray bars of the type used on distributor trucks. These are mounted on

This photo shows the uniform spread of thoroughly mixed cement stabilized base material as the P & H Stabilizer processes 1,275 square yards per hour

top of the box spraying water through slots in the top just ahead of the first row of mixing paddles. It was noted that the nozzles immediately adjacent to the sides of the mixing chamber frequently became clogged with cement, dust and sand. However, they were readily cleaned without stopping the machine. The water is turned on and off very positively with no dribbles. Any nozzle may be turned off without disturbing the others.

Little Hand Work Required

A distinct advantage of this machine is that it can be backed into position at a bridge end or transverse joint and the box lowered into position with the shafts in motion, mixing to full depth almost against the structure or joint.

A distinct disadvantage is that the mixing chamber is either 8 or 10 feet in width and no practical mechanical means of varying this width has been developed. Therefore at present the areas to be mixed should preferably be an even multiple of 8 or 10 feet. Either the 8- or 10-foot mixing chamber may be installed on the same machine. Mixing a 6-foot strip with the 8-foot box was accomplished by applying a strip of cement six feet wide and leaving two feet of shoulder area uncovered. Then the entire 8-foot strip was mixed, the assumption being that none of the cement would migrate into the 2-foot strip.

Suggested Improvement

Since the pugmill paddles are set at different angles to deflect the material transversely, some cement was undoubtedly thrown into the 2-foot strip. This amount could not be determined. This could possibly be avoided by installing a vertical "cut-off" plate longitudinally in the box and straddling the shafts of the pugmill paddles. Such plates are *not* manufactured for the machine.

In mixing material on a steeply superelevated curve the mixed material tends to move to the lower side of the superelevation leaving an area of variable width along the upper edge of the strip with little or no material in it. This requires redistribution of the mixed material with the motor patrol. As a motor patrol is required for finish cutting of the rolled base this disadvantage of the machine is not of great consequence.

Adjustments

As the cutting, blending, and mixing paddles are mounted on four transverse shafts, not articulated, the bottom of the excavation is always a plane surface and cannot be crowned. When required to mix a strip down the center of the road it became necessary to find a means of obtaining the desired crown. On the rear of the mixing chamber is a controllable screed or "tail-gate." This was raised and two cutting edges from a motor grader blade were installed with the holes near centerline slotted vertically for adjustment. For a 2 percent slope for four feet (½ box width) the ends of the blades at centerline were raised 0.08 foot above the outer ends. This afforded the necessary crown on the surface but of course left the mix .58 feet thick at the center instead of the designated 0.50 foot. The cement content was not increased to provide for the increased depth; consequently the strength of the base at centerline should theoretically be less than at the edges of the strip.

Operations

On the projects in the vicinity of Orick the efficiency of the cement spreading device was found to be questionable. After considerable changing of sprockets and base plates the proper spread of cement per station for the mixing width was obtained but the cement was not uniformly spread transversely. Representatives of the P and H Company felt that during mixing the soil stabilizing machine would distribute the cement uniformly

The thoroughly mixed cement, water and road material was compacted immediately behind the stabilizer by a heavy steel wheel roller. Traffic used the new base as soon as a lane was completed

over the 8-foot width. Rather than risk uneven distribution the contractor was required to furnish a man with a push broom to spread the cement in a blanket of uniform depth ahead of mixing. After mixing specimens were taken across the strip and adjacent strips.

The digging and mixing speeds of the machine are 6.2, 10.8, 18.5, 26.7, and 32.9 feet per minute with a forward maneuvering speed of 46.7 feet per minute. Reverse speeds are 26.0, 45.5, 78.0, 139.0, and 196.0 feet per minute.

On this particular project 69,000 square yards of cement treated base six inches deep were road mixed in an operating time of 52¾ hours and an elapsed time of 83¾ hours.

Maintenance Not Difficult

Lost time was six hours due to weather, 10 hours due to maintenance, 14 hours due to maintenance on the cement spreader and waiting for cement, and one hour due to delay in resetting stolen centerline offset stakes.

The maintenance consisted entirely of replacing the cutting teeth. No blending blades or pugmill blades were replaced during this project although at the conclusion of the work replacement of some of the latter was necessary. There were no breakdowns and as indicated above the greatest delay was experienced with the cement spreader and in waiting for cement which was hauled from Eureka to Orick, 49 miles, in 10-yard dump trucks.

This machine was found to be capable of doing a large amount of work very rapidly with a minimum of inconvenience to passing traffic. The surface of the finished cement treated base was left smooth and few pot holes developed under traffic. The strength of the mixture was good as is shown by the test results.

Tests Results Satisfactory

It was the opinion of the district that mixing with this machine produced as thorough and uniform a product as could be produced by road mix methods. On the basis of test results the latter part of the work was done with the cement content reduced from 5 percent to 4.5 percent and compressive strength still remained well above the required minimum.

The contractor believes the machine has some distinct advantages. It is quite maneuverable which makes it easy to move into position for the beginning of a day's work and to move about on the job. The only maintenance item is the replacement of teeth and paddles and this is done very rapidly by merely tapping them out of tapered sockets with a hammer. New ones are placed in the sockets and secured by a few taps of a hammer. The cutting teeth are rather expensive, being made of a special material, and when mixing a tightly compacted gravel wear is fairly rapid.

The machine can be loaded quickly on a low bed trailer under its own power but an over-width permit is required for its movement over highways. It is equipped with twin G. M. C. diesel engines and though its initial cost new is about $42,000 the contractor believes the investment was worthwhile for the type of work for which it was purchased. Next spring he proposes to use the machine to mix

. . . Continued on page 57

New Booklet on State Government

California State Government: A Guide to Its Organization and Functions, 1951, is a new 112-page publication prepared in response to a widespread demand from students, teachers, and the general public for a concise, nontechnical description of State Government as it exists and operates.

The agencies of the State of California, and the functions they perform, are described in clear, understandable language under 10 group headings: General Control Agencies, Correctional Agencies, Educational Agencies, Mental Hygiene Agencies, Natural Resources Agencies, Public Health Agencies, Public Safety Agencies, Public Works Agencies, Regulative Agencies, and Security and Welfare Agencies. Their organization and interrelationship are illustrated by means of simple, legible charts.

In his foreword to this booklet, Governor Earl Warren states: "Our State Government is an enterprise in which every California citizen has a stake. Yet relatively few of us have the opportunity to know first-hand the diversity of our state governmental services, or know how our State Government is organized to do its job."

The publication is priced at 50 cents, plus sales tax for California addresses, and may be obtained from the Documents Section, Printing Division, 11th and O Streets, Sacramento 14, California. Orders should be accompanied by remittance, since purchase orders can only be accepted from public agencies.

Successful Test

Continued from page 56 . . .

road mixed surfacing on his Contract 1-1DC12, FAS-975. Grades on this project include a section of 10 percent and operation of the machine on this grade and for this type of mixing is being looked forward to with interest by the district.

DISTRICT SHOP 8 RECEIVES "CERTIFCATE OF MERIT"

By RUSSELL J. STANDING, District Safety Supervisor

District Highway Engineer Spencer W. Lowden, left, presents certificate to Albert A. Hilton, right. In center, C. P. Coote and Roy S. Milnor

When a group of people work 174,-734 hours without a lost time accident it is a record that merits consideration and honor.

District Highway Shop 8 in San Bernardino piled up a record of two years and seven months without time lost due to accidents, and has now been duly honored for that record.

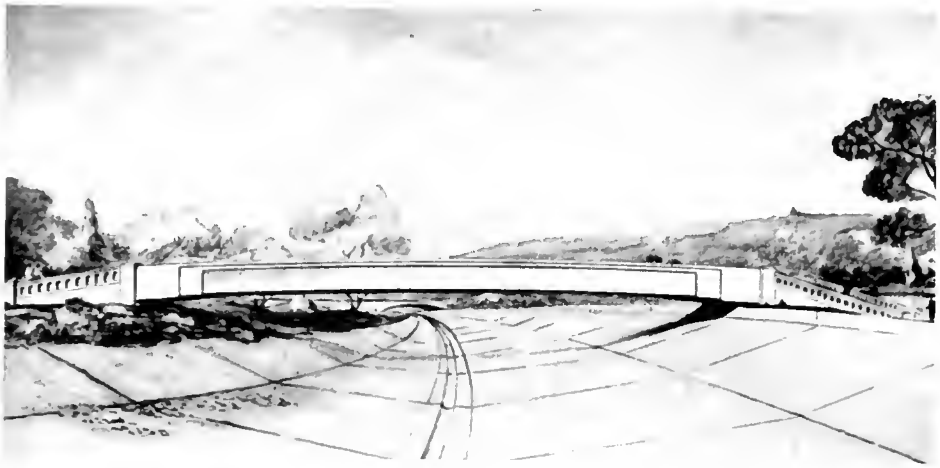
The District Shop has 35 employees, most of whom work with heavy equipment and machinery used in highway maintenance and construction. This work is under the direction of Albert A. Hilton, equipment superintendent, who has supervised shop work in District VIII for the past nine years. Prior to this time, Hilton was shop foreman at Shop 7, North Hollywood for 21 years.

In a ceremony at Shop 8 Monday, January 8, 1951, a "Certificate of Merit" was presented to Hilton, C. P. Coote, shop foreman, and Ray S. Milnor, assistant shop foreman, by Spencer W. Lowden, District Engineer, District VIII, for the shop employees. The certificate is signed by C. H. Purcell, Director of Public Works, and G. T. McCoy, State Highway Engineer.

Mr. Lowden gave an inspirational talk to the employees, commending them for their record, and encouraging them to continue their loyalty and efforts.

Members of the District Safety Committee on hand to witness the presentation and offer their congratulations were: L. R. McNeely, Assistant District Engineer, Chairman of the Committee; Almon Coonrod, District Office Engineer; G. E. Malkson, District Maintenance Engineer; Loren S. Moore, District Traffic Engineer, and Russell J. Standing, Secretary.

California Builds A Prestressed Bridge



Arroyo Seco pedestrian bridge

The accompanying photo of a sketch by the Bridge Department artist is a view looking upstream on the Arroyo Seco channel showing a reinforced concrete pedestrian bridge now under construction. The channel roughly parallels the Arroyo Seco Parkway at this point in the vicinity of Avenue 58, Los Angeles. The contractor is Walter Kaucher of Los Angeles, who is presently more than half-way through his work.

This structure, 110-foot span and 8-inch width, is unique in the fact that it is the first of its type to be built in California and employs wires rather than bars for reinforcing. These wires are so located and stressed in advance of their being subjected to passing loads as to counteract the bending stresses. The resultant reduction in the amount of concrete and reinforcing steel in the superstructure provides lightness and good appearance. The economy in weight carries through to the foundations which are obviously lighter than orthodox construction.

The beams are being constructed on the ground at the site where they will be prestressed. Upon the completion of these operations and a seasoning period the beams will be lifted into final position by two cranes. This method speeds the contract, saves the expense of supporting timber work required when the deck is built in final position and avoids the hazard of loss which might result if the channel were occupied by falsework timber during flood. Subsequent articles in this magazine will cover later developments.

R. H. BALDOCK RECEIVES BARTLETT AWARD FOR 1950

R. H. (Sam to his friends) Baldock, chief engineer of the Oregon State Highway System and former director of ARBA, is the winner of the 1950 George Bartlett award. Presentation was made at the annual meeting of the American Association of State Highway Officials in Miami. The AASHO, the American Road Builders' Association and the Highway Research Board of the National Research Council cooperate in selecting the winner of the award for outstanding highway service each year.

SIGNS AND SIGNALS

Two-thirds of all traffic deaths happen at night, according to the California State Automobile Association. Your best defense against after-dark hazards is common sense obedience to warning signs and signals.

In Memoriam

MARSHALL H. HUBBS

Marshall H. Hubbs, Supervising Highway Engineer, Headquarters Office, passed away suddenly November 26, 1950, while on a hunting trip in Yolo County.

Marshall, or "Tex" as he was known to some of his more intimate friends, was born in San Marcos, Texas, July 26, 1888. His early schooling was obtained in the Hays County public schools and the Lone Star College in San Marcos. He came to California in 1910 where for a short time he worked in the Imperial Valley and soon after went to work for the Southern Pacific Company on a survey party.

He first entered state service September 29, 1914, on survey work for the Highway Commission in Division IV, and subsequently was assigned to construction as an Assistant Resident Engineer. During one of the intervals in state service he worked for a time for the City and County of San Francisco as an engineer on the Hetch-Hetchy water development, both on surveys and construction, where he made a host of friends among the early administrators of that great project. He also worked during 1919-20 as Resident Engineer on highway construction for Contra Costa County.

Re-entering state service in August, 1921, he served continuously until his death, rising from Assistant Resident Engineer and Resident Engineer in District I to Senior Highway Engineer in District V, and later to Supervising Highway Engineer at Headquarters Office.

Due to his wealth of construction experience Marshall Hubbs was selected by the late Charles Stockton Pope, then Construction Engineer, to write the Fourth Edition of the Construction Manual in 1938, which edition prevailed as the guiding authority on construction practice until 1950.

His many friends and associates are greatly saddened by Marshall's passing and extend to his widow, Ruth, their heartfelt sympathy.

HIGHWAY BIDS AND AWARDS

November, 1950

ALAMEDA COUNTY—In the City of Oakland, between 38th Avenue and Fallon Street, about 2.8 miles of roadside areas to be prepared and planted. District IV, Route 69. J. Henry Harris, Berkeley, $89,503; Watkin and Sibbald, San Anselmo, $97,700; Huettig, Schromm and Bennett, Palo Alto, $98,574; Leonard Coates Nurseries, Inc., San Jose, $2,441,093. Contract awarded to Justice-Dunn Co., Oakland, $89,079.55.

BUTTE COUNTY—Across Tule Canal and Biggs Extension Canal, about 1.7 miles west of junction Route 3, two existing bridges to be widened with reinforced concrete construction. District III, Route 45, Section A. Eugene G. Alves, Pittsburg, $20,977; O'Connor Bros., Red Bluff, $21,977; Transocean Engineering Corp., San Lorenzo, $22,989; C. C. Gildersleeve, Nevada City, $27,316. Contract awarded to B. S. McElderry, Berkeley, $19,928.

HUMBOLDT COUNTY — Between Robinson Ferry Bridge and Alton Grade Crossing, about 4.4 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and bridge to be constructed. District I, Route 1, 35, Sections E, F, A. Clyde W. Wood and Sons, Inc., North Hollywood, $983,528; Fred J. Early Jr. Co., Inc., Mercer Fraser Co., Inc., Mercer Fraser Gas Co., Inc., San Francisco, $1,093,655; N. M. Ball Sons, Berkeley, $1,012,471; Piombo Construction Co., M. K. Corporation, and Clements and Co., San Francisco, $1,139,426; Harms Brothers and C. M. Syar, Sacramento, $1,165,394; United Concrete Pipe Corporation and Ralph A. Bell, Baldwin Park, $1,373,249; Parish Brothers and Healy Tibbitts Construction Co., Benicia, $1,430,790. Contract awarded to Fredrickson Brothers, Emeryville, $946,610.29.

INYO COUNTY—At District IX Yard in Bishop, furnishing and erecting a prefabricated metal building. District IX, Route 23, Section D. Kyle Steel Construction Co., Vernon, $8,935; Valley Steel Construction, Bakersfield, $11,947. Contract awarded to Pascoe Steel and Construction Co., Pomona, $8,844.00.

LOS ANGELES COUNTY—On Hollywood Freeway at Van Ness Avenue, in the City of Los Angeles, two reinforced concrete box girder bridges to be constructed and road connections to be graded and paved. District VII, Route 2. Webb and White, Los Angeles, $318,768; MacDonald and Kruse, Sun Valley, $321,082; Charles T. Brown Co., San Fernando, $330,023; Fredericksen and Kasler, Sacramento, $330,139; George W. Peterson and Jack W. Baker, Los Angeles, $33,046; Carlo Bongiovanni, Los Angeles, $354,745; Charles MacClosky Co., San Francisco, $358,479. Contract awarded to J. E. Haddock, Ltd., Pasadena, $308,813.70.

LOS ANGELES COUNTY—On Santa Ana Freeway, between Eastman Avenue and 0.1 mile westerly of Atlantic Boulevard, portions, about 1.1 mile to be graded and portions surfaced with Portland cement concrete pavement on cement treated surface, interchange roadways, acceleration and deceleration lanes and outer highways to be surfaced with plant-mixed surfacing on untreated rock base; two grade separation structures and one pedestrian overcross structure to be constructed to provide a freeway with a six-lane divided roadbed. District VII, Routes 2 and 166, Sections D, A. J. E. Haddock, Ltd., Pasadena $1,162,527; United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,185,732; Webb and White, Los Angeles, $1,188,122; Griffith Co., Los Angeles, $1,202,518; Guy F. Atkinson Co., Long Beach, $1,208,500; Peter Kiewit Sons' Co., Arcadia, $1,234,450; N. M. Ball Sons and Ericksen Philips and Weisberg, Berkeley, $1,245,779. Contract awarded to Winston Brothers Co., Monrovia, $1,112,920.20.

LOS ANGELES COUNTY—In the Cities of Monterey Park and Montebello at the intersections of Atlantic Boulevard with El Portal Place, Harding Avenue, and Newmark Avenue, and Garvey Avenue with Hitchcock Drive, and Pomona Boulevard with Findley Avenue, semi-traffic actuated signal systems at five intersections and highway lighting at one intersection to be furnished and installed. District VII, Routes 26, 167, 172. Fishbach and Moore of California, Inc., Los Angeles, $21,955; Ets-Hokin and Galvan Inc., Wilmington, $22,560; Electric and Machinery Service, Inc., South Gate, $22,714; Clinton Electric Corporation, Burbank, $22,856; C. D. Draucker Inc., Los Angeles, $23,685. Contract awarded to Westates Electrical Construction Co., Los Angeles, $18,929.

LOS ANGELES COUNTY—Between La Verne Avenue and Eastland Avenue, about 0.6 mile, roadside development to be performed. District VII, Route 166, Section A. Moulder Bros., Glendale, $20,915; Stephen L. Vistica, San Mateo, $24,495; Jannoch Nurseries, Altadena, $26,502. Contract awarded to Henry C. Soto Corp., Los Angeles, $19,812.

ORANGE COUNTY—Between Heim Avenue and Peralta School, about 4.6 miles, the central dividing strip, the tops of fill slopes and other areas to be planted with Mesembryanthemum edule (ice plant) cuttings. District VII, Route 43, Section B. Justice-Dunn Co., Oakland, $12,736; Huettig, Schromm and Bennett, Palo Alto, $13,942; Henry C. Soto Corp., Los Angeles, $15,428; Jannoch Nurseries, Altadena, $17,606. Contract awarded to D. and M. Sprinkler Co., Long Beach, $11,816.93.

ORANGE COUNTY—At the intersection of Grand Avenue with Orangethorpe Avenue, traffic signal and highway lighting system to be furnished and installed. District VII, Route 171, Section B. Westates Electrical Construction Co., Los Angeles, $9,680; Clinton Electric Corp., Burbank, $9,966; E. D. Johnson, Anaheim, $10,740; Fischbach and Moore, Los Angeles, $11,367. Contract awarded to Electric and Machinery Service Inc., South Gate, $9,090.

RIVERSIDE COUNTY—Between 1 mile north of Temecula and Antelope Road, about 7.0 miles, to be graded and surfaced with plant-mixed surfacing on cement treated base and three reinforced concrete slab bridges to be constructed. District VIII, Routes 77, 78, Sections A, C. Basich Brothers Construction Co., R. L. Basich-N. L. Basich, San Gabriel, $627,201; E. L. Yeager Co., Riverside, $634,772; N. M. Ball Sons, Berkeley, $638,444; McKinley and Kirk Construction Co., Paramount, $639,329; Peter Kiewit Sons Co., Arcadia, $642,713; Claude Fisher Co., Ltd., Los Angeles, $647,373; Foster and McHarg, Riverside, $651,152; R. P. Shea Construction Co., Indio, $654,843; Westbrook and Pope and Clements and Co., Sacramento, $658,239; Ralph R. Slaughter and Anderson Co., Julian, $667,893; George Herz and Co., San Bernardino, $674,395; Winston Brothers Co., Monrovia, $674,659; Clyde W. Wood and Sons, Inc., North Hollywood, $674,919; Dimmitt and Taylor and T. M. Page, Monrovia, $724,293; United Concrete Pipe Corp., and Ralph A. Bell, Baldwin Park, $728,308; Griffith Co., Los Angeles, $740,026; A. Teichert and Son, Inc., Sacramento, $742,149; Cox Brothers Construction Co., Stanton, $764,764. Contract awarded to L. A. and R. S. Crow, El Monte, $617,930.50.

RIVERSIDE COUNTY—Between Imperial County line and three miles southeast of Mecca, about 14.8 miles to be graded and surfaced with road-mixed surfacing on imported base material. District XI, Route 187, Section A. B. Westbrook and Pope, W. C. Lefever and D. G. Bing, Sacramento, $544,447; Basich Brothers Construction Co., R. L. Basich and N. L. Basich, San Gabriel, $554,982; Hensler Construction Corp., Sun Valley, $559,704; Rice Brothers Inc., Marysville, $573,525; R. P. Shea Const. Co., Indio, $593,739; Dimmitt and Taylor and T. M. Page, Monrovia, $601,727; McKinley and Kirk Construction Co., Paramount, $613,481; R. A. Erwin, Colton, $621,527; Webb and White, Los Angeles, $626,109; Clyde W. Wood and Sons, Inc., North Hollywood, $626,175; Claude Fisher Co. Ltd., Los Angeles, $628,291; E. L. Yeager Co., Riverside, $630,239; Cox Brothers Construction Co. and J. E. Haddock, Ltd., Pasadena, $639,930; Arthur H. Famularo and Roland T. Reynalds, Anaheim, $690,811; Ralph A. Bell, Monrovia, $737,847. Contract awarded to Griffith Co., Los Angeles, $533,704.40.

RIVERSIDE COUNTY—Between 7.8 and 8.2 miles north of Route 26 in Dry Morongo Canyon, about 0.4 mile to be graded, imported base material to be furnished and placed, and bituminous surface treatment to be applied thereto. District VIII, Route 187, Section E. Fred McKinley, Paramount, $31,989; Ken Lowe, San Bernardino, $33,734; Anderson Co., Visalia, $34,623; E. L. Yeager Co., Riverside, $35,212; E. S. and N. S. Johnson, Fullerton, $35,997; Paul E. Woof, Fresno, $36,683; Foster and McHarg, Riverside, $46,996; Frank Day, Big Bear Lake, $47,858; M. S. Mecham and Sons, South Gate, $49,850. Contract awarded to R. P. Shea Co., Indio, $28,416.75.

SACRAMENTO COUNTY—On 12th Street and 16th Street between Sacramento city limits and American River Bridge. The existing pavement to be surfaced with plant-mixed surfacing and widening strips to be graded and surfaced with plant-mixed surfacing on crushed rock base. District III, Route 3, Section B. Harms Brothers, Sacramento, $14,780; A. Teichert & Son, Inc., Sacramento, $15,786; Brighton Sand & Gravel Co., Sacramento, $16,093; McGillivray Construction Co., Sacramento, $18,491. Contract awarded to J. R. Reeves, Sacramento, $13,541.20.

SAN BERNARDINO COUNTY—In the City of San Bernardino, at Fifth and I Streets, a structural steel railroad overhead to be constructed, about 0.3 mile to be graded and surfaced with plant-mixed surfacing on crusher run base, and a lighting system to be installed. District VIII, Route 9. Fepco, Los Angeles, $410,425; J. E. Haddock, Ltd., Pasadena, $411,680; Webb and White, Los Angeles, $419,471; Ralph A. Bell, Monrovia, $428,069; Griffith Co., Los Angeles, $429,423; George Herz and Co., San Bernardino, $446,987. Contract awarded to K. B. Nicholas, Ontario, $385,574.

SAN DIEGO COUNTY—Between Wildwood Glen and Descanso Junction, about 0.8 mile to be graded and surfaced with road-mixed surfacing on base material and a structural steel girder bridge to be constructed across Sweetwater River. District XI, Route 12, Section D. Winston Brothers Co., Monrovia, $395,916; McKinley and Kirk Construction Co., Paramount, $397,194; Walter H. Barber and H. R. Breeden, La Mesa, $438,045; Webb and White, Los Angeles, $446,941; Ralph A. Bell, Monrovia, $467,457; Cox Brothers Construction Co., Stanton, $468,337; C. B. Tuttle Co., Long Beach, $479,725; Guy F. Atkinson Co., Long Beach, $498,400. Contract awarded to Clyde W. Wood and Sons, Inc., North Hollywood, $369,668.10.

SAN JOAQUIN COUNTY—Across Old River and Middle River, about 17 miles and 12 miles west of Stockton, the fenders of two existing bridges to be repaired. District X, Route 75, Section A. Ben C. Gerwick, Inc., San Francisco, $21,986; The Duncanson-Harrelson Co., Richmond, $25,630; H. F. Lauritzen, Pittsburg, $26,755; Pomeroy Sinnock, Stockton, $33,668. Contract awarded to Healy Tibbitts Construction Co., San Francisco, $20,829.

SANTA CLARA COUNTY—On Bayshore Highway at Fourth Street Extension, a full traffic actuated signal system and highway lighting to be furnished and installed, and channelization to be constructed. District IV, Route 68, Section B. A. J. Raisch Paving Co., San Jose, $19,878; Granite Construction Co., Watsonville, $20,850; Leo F. Piazza Paving Co., San Jose, $21,926; J. Henry Harris, Berkeley, $23,795. Contract awarded to Edward Keeble, San Jose, $18,485.75.

TULARE COUNTY—At the intersection of Mineral King Avenue with Conyer Street, in the City of Visalia, a traffic signal system and highway lighting. District VI, Route 10, L. H. Leonardi Electric Construction Co., San Rafael, $4,100; R. O. Ferguson Co., Visalia, $4,121; Westates Electrical Construction Co., Los Angeles, $4,142. Contract awarded to Clinton Electric Corp., Burbank, $3,966.

TULARE COUNTY—At the east city limits of Tulare, at the proposed Route 134 overcrossing, highway lighting system to be installed. District VI, Route 134, Section B. R. O. Ferguson Co., Visalia, $8,859; Robinson Electric, Fresno, $13,125. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $8,543.

VENTURA COUNTY—At various locations between Route 79 and Los Angeles County line, six bridges to be widened and a bridge to be constructed, including approaches thereto. District VII, Route 9, Section A, B, C. Barringer and Botke, Santa Paula, $95,452; E. G. Perham, Los Angeles, $96,827; Ralph A. Bell, Monrovia, $103,061; J. E. Haddock, Ltd., Pasadena, $105,261. Contract awarded to Norman I. Fadel, North Hollywood, $89,747.50.

YOLO AND SACRAMENTO COUNTIES—On bridge across the Sacramento River at Sacramento, the existing Portland cement concrete curbs to be removed and new Portland cement concrete curbs and raised traffic bars to be constructed. District III, Route 6, Section C, Sacramento. D. M. Sandling, San Pablo, $8,675; Brighton Sand and Gravel Co., Sacramento, $8,725; B. S. McElderry, Berkeley, $11,880. Contract awarded to A. Teichert & Son, Inc., Sacramento, $7,767.

YOLO COUNTY—On West Sacramento Freeway, over Jefferson Boulevard, about one mile west of the city limits of Sacramento, a reinforced concrete slab bridge to be constructed, and about 0.2 mile to be graded and surfaced with plant-mixed surfacing on crushed rock base. District III, Route 6, Section C. Chittenden and Chittenden and B. S. McElderry, Auburn, $81,699; Holdener Construction Co., Sacramento, $85,183; The Utah Construction Co., Richmond, $97,007. Contract awarded to Charles MacClosky Co., and Harms Brothers, San Francisco, $76,346.

F. A. S. County Roads

MADERA COUNTY—Across Kaiser Fork and North Fork of San Joaquin River, near North Fork, two reinforced concrete girder bridges to be constructed. District VI, Route 962. Transocean Engineering Corp., San Lorenzo, $42,550; Trewhitt-Shields and Fisher, Fresno, $45,695; Chittenden and Chittenden and B. S. McElderry, Auburn, $46,565; Granite Construction Co., Watsonville, $50,230. Contract awarded to C. C. Gildersleeve, Nevada City, $39,915.

KERN COUNTY—Across Kern River at Gordon's Ferry on China Grade Loop, about 4.5 miles north of Bakersfield, a reinforced concrete slab bridge to be constructed. District VI, Route 886. Chittenden and Chittenden and B. S. McElderry, Auburn, $80,591; Concrete Construction Service, Inc., Gardena, $84,338; G. M. Carr and Bati Rocca, Santa Rosa, $84,658; Erickson, Phillips and Weisberg, Oakland, $88,105; Tumblin Co., Bakersfield, $88,662; Griffith Co., Los Angeles, $89,368; J. E. Haddock Ltd., Pasadena, $89,527; Trewhitt-Shields, and Fisher, Fresno, $90,458; Dan Caputo, San Jose, $93,475; Granite Construction Co., Watsonville, $94,924; E. G. Perham, Los Angeles, $96,961; Norman I. Fadel, North Hollywood, $101,098. Contract awarded to Madonna Construction Co., San Luis Obispo, $75,980.

KERN COUNTY—Across Beardsley Canal and at Beardsley School, about 0.6 and 0.4 mile north of Junction Route 4, a reinforced concrete slab bridge and a reinforced concrete box pedestrian undercrossing to be constructed. District VI, Route 881. Trewhitt-Shields and Fisher, Fresno, $40,294; G. M. Carr, Santa Rosa, $41,909; Chittenden and Chittenden and B. S. McElderry, Auburn, $43,361; Norman I. Fadel, North Hollywood, $46,230; Granite Construction Co., Watsonville, $46,822. Contract awarded to Griffith Co., Los Angeles, $39,567.40.

FRESNO COUNTY—Across Kings River, about one mile west of Reedley, a reinforced concrete bridge to be widened. District VI, Route 817. E. G. Perham, Los Angeles, $98,505; Granite Construction Co., Watsonville, $101,827; Chittenden and Chittenden and B. S. McElderry, Auburn, $103,130; Bent Construction Co., Los Angeles, $113,540; Dan Caputo, San Jose, $120,930; Trewhitt-Shields and Fisher, Fresno, $134,737. Contract awarded to Thomas Construction Co., Fresno, $95,610.

FRESNO COUNTY—On Shaw Avenue between State Highway Route 4 and Fruit Avenue, about 3.3 miles to be graded and surfaced with plant-mixed surfacing on cement treated base and a reinforced concrete slab bridge to be constructed. District VI, Route 561. P. J. Moore and Son, North Sacramento, $119,266; Rice Brothers, Inc., Marysville, $121,448; Volpa Brothers, Fresno, $128,381; Ted F. Baun, Fresno, $131,037; Roland T. Reynolds and Thomas Construction Co., Fresno, $137,315; Harms Brothers, Sacramento, $138,380; Louis Biasotti and Son, Stockton, $139,802; Granite Construction Co., Watsonville, $142,861. Contract awarded to Gene Richards, Fresno, $110,479.60.

RIVERSIDE COUNTY—On Lakeview Avenue, between Nueva and Lakeview, about 2.9 miles to be graded and surfaced with road-mixed surfacing on cement treated base. District VIII, Route 718. E. S. and N. S. Johnson, Fullerton, $77,957; Clyde W. Wood and Sons, Inc., North Hollywood, $78,722; E. L. Yeager Co., Riverside, $78,991; George Herz and Co., San Bernardino, $82,435; Ken Lowe, San Bernardino, $85,499; Cox Brothers Construction Co., Stanton, $87,660; Ralph B. Slaughter, Julian, $88,507; R. A. Erwin, Colton, $100,502. Contract awarded to Foster and McHarg, Riverside, $73,466.

December, 1950

ALAMEDA COUNTY—At San Miguel Avenue in Castro Valley about 0.2 mile, the existing pavement to be widened with crusher run base on imported subbase material and the existing pavement and newly constructed crusher run base surface with plant-mixed surface and a seal coat applied and a full traffic actuated signal system to be furnished and installed. District IV, Route 5, Section B. Transocean Engineering Corp., San Lorenzo, $25,203; Clements and Co., Hayward, $25,491; Eugene G. Alves, Pittsburg, $26,116; J. Henry Harris, Berkeley, $26,833. Contract awarded to Gallagher and Burk, Inc., Oakland, $23,495.25.

CONTRA COSTA COUNTY—At Walnut Creek near south city limits of Walnut Creek, existing bridge to be widened and about 0.2 mile of approaches to be widened and surfaced with plant-mixed surfacing on crusher run base. District IV, Route 107, Section A. Transocean Engineering Corp., San Lorenzo, $38,179; Lee J. Immel, San Pablo, $40,761; O. C. Jones and Sons, Berkeley, $43,734; Eugene G. Alves, Pittsburg, $48,999; J. Henry Harris, Berkeley, $49,699. Contract awarded to H. H. Anderson, San Leandro, $36,958.25.

KERN COUNTY—On Brundage Lane at Central Branch Canal and Kern Island Canal, two existing culverts to be extended. District VI, Route 141, Section A. Contract awarded to E. G. Perham, Los Angeles, $27,145.

LOS ANGELES COUNTY—In the Cities of Los Angeles, South Pasadena and Pasadena, on Figueroa Street-Arroyo Seco Freeway between College Street and Glenarm Street, highway lighting and illuminated sign systems to be furnished and installed. District VII, Routes 165, 205. Fischbach and Moore of California, Inc., Los Angeles, $48,877; Ets-Hokin and Galvan, Inc., Wilmington, $50,586; Newberry Electric Corp., Los Angeles, $53,595. Contract awarded to Electric and Machinery Service, Inc., South Gate, $45,871.

LOS ANGELES COUNTY—City of Los Angeles, on Hollywood Freeway, between Western Avenue and Virgil Avenue, highway lighting and illuminated sign systems to be furnished and installed. District VII, Route 2. Newberry Electric Corp., Los Angeles, $54,435; R. E. Ziebarth, Torrance, $54,855; Electric and Machinery Service, Inc., South Gate, $58,161; Ets-Hokin and Galvan, Inc., Wilmington, $59,345; State Construction Co., Los Angeles, $64,895; Westates Electrical Construction Co., Los Angeles, $65,970. Contract awarded to Fischbach and Moore of California, Inc., Los Angeles, $52,494.

LOS ANGELES COUNTY—On Harbor Freeway at Fifth and Sixth Streets in the City of Los Angeles, five reinforced concrete bridges for overcrossings and two pedestrian undercrossings to be constructed, and various adjacent roadways and streets to be graded and surfaced with asphalt concrete pavement and plant-mixed surfacing. District VII, Route 165. Webb and White, Los Angeles, $999,940; Granite Construction Co., Watsonville, $1,003,838; Charles MacClosky Co., and C. G. Willis and Sons, San Francisco, $1,038,350; J. E. Haddock, Ltd., Pasadena, $1,051,065; MacDonald and Kruse, Sun Valley, $1,070,459; Guy F. Atkinson Co., Long Beach, $1,086,821; W. J. Disteli and R. J. Daum Construction Co., Los Angeles, $1,097,168; United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,105,030; Carlo Bongiovanni, Hollywood, $1,133,425. Contract awarded to Winston Brothers Co., Monrovia, $956,067.45.

LOS ANGELES COUNTY—In the City of Los Angeles, between Beaudry Avenue and Grand Avenue, about 0.4 mile of roadside areas to be prepared and planted. District VII, Route 2. Huettig and Schromm and Bennett, Palo Alto, $39,012; Henry C. Soto Corp., Los Angeles, $39,716; Moulder Brothers, Glendale, $43,573; Stephen L. Vistica, San Mateo, $46,473. Contract awarded to Jannoch Nurseries, Altadena, $34,409.75.

LOS ANGELES COUNTY—At the intersection of Firestone Boulevard with Church Street, traffic signal system to be furnished and installed, at intersections of Firestone Boulevard with Paramount Boulevard, La Reina Avenue, and Downey Avenue, traffic signal systems to be modified. District VII, Route 174, Section B. Westates Electrical Construction Co., Los Angeles, $9,375; C. D. Draucker, Inc., Los Angeles, $10,987; Electric and Machinery Service, South Gate, $11,049. Contract awarded to Fischbach and Moore of California, Inc., Los Angeles, $8,730.

MONTEREY COUNTY—At Sanborn Road intersection, about one-half mile south of Salinas, about 0.1 mile, acceleration and deceleration lanes to be graded and surfaced with plant-mixed surfacing on crusher run base. District V, Route 2, Section B. Contract awarded to Granite Construction Co., Watsonville, $9,983.45.

SAN DIEGO COUNTY—In the City of Oceanside at the intersection of Cassidy Street with Hill Street, traffic signal system and highway lighting to be furnished. District XI, Route 2. Ets-Hokin and Galvan, San Diego, $10,100. Contract awarded to California Electric Works, San Diego, $9,884.

SAN MATEO COUNTY—On Bayshore Highway between south city limits of San Francisco, and north city limits of South San Francisco, about 3.2 miles to be widened and paved with plant-mixed surfacing on cement treated base. District IV, Route 68, Section A, SSF. Morrison-Knudsen Co., Inc., Los Angeles, $369,180; Eaton and Smith, San Francisco, $405,163; Guy F. Atkinson, South San Francisco, $419,112. Contract awarded to Charles L. Harney, Inc., San Francisco, $348,037.70.

SAN JOAQUIN COUNTY—Across Paradise Cut Overflow, about six miles east of Tracy, a timber trestle bridge on timber pile bents to be constructed. District X, Route 5, Section B. Lew Jones Construction Co., San Jose, $17,284; Dan Caputo, San Jose, $21,508; The Duncanson-Harrelson Co., Richmond, $23,856; Nomellini Construction Co., Stockton, $25,966; Al. Erickson and Co., Napa, $30,768; Healy Tibbitts Construction Co., San Francisco, $35,900; Johnson, Drake and Piper, Inc., Oakland, $35,940; Ben C. Gerwick, Inc., San Francisco, $45,080. Contract awarded to Lord and Bishop, Sacramento, $12,480.

SANTA CRUZ COUNTY—In the City of Santa Cruz at Ocean and Water Streets, construction of channelization and alteration of traffic signals. District IV, Routes 5, 56. Granite Construction Co., Watsonville, $9,960; Caputo and Keeble, San Jose, $11,220; Guerin and Morgan, Los Gatos, $12,801. Contract awarded to Leo F. Piazza Paving Co., San Jose, $9,699.50

SHASTA COUNTY—Office building to be painted. District II, Redding. E. W. Peterson, Yreka, $2,250. Contract awarded to H. L. Barnes, Redding, $2,057.

SOLANO COUNTY—Between Alamo Creek and Ulatis Creek, about 1.7 miles to be graded and surfaced with Portland cement concrete and plant-mixed surfacing and two parallel grade separation structures and two parallel bridges to be constructed. District X, Route 7, Section C, Vac, D. Fredrickson and Watson Construction Co., Oakland, $869,514; Parish Bros., Benicia, $874,077; Harms Brothers and Charles MacClosky Co., Sacramento, $941,296: Lord and Bishop and M. J. B. Construction Co., Sacramento, $1,004,346. Contract awarded to Fredrickson Brothers, Emeryville, $782,675.55.

. . . Continued on page 64

U. S. SUPREME COURT UPHOLDS CALIFORNIA

In the July-August, 1950, issue of *California Highways and Public Works*, Deputy Director of Public Works Frank B. Durkee discussed in detail the opinion of the California Supreme Court in the important case of Holloway vs. Purcell, arising out of the proposed relocation as a freeway of the state highway (U. S. 40) between North Sacramento and Roseville in Sacramento and Placer Counties.

Subsequent to the time the above article was written, the plaintiffs petitioned the United States Supreme Court for a writ of certiorari to review the decision of the State Supreme Court. On November 13, 1950, the Supreme Court of the United States unanimously denied the petition for a writ of certiorari. This had the effect of affirming the decision of the State Supreme Court in its holding that the California Highway Commission has authority to approve the relocation of state highways, including highways constructed or acquired under the State Highway Act of 1909 (the original State Highway Bond Issue) and also in upholding the California Freeway Law as valid and constitutional.

Montgomery Freeway

Continued from page 36 . . .

31-foot 6-inch spans supported on concrete bents and abutments resting on timber foundation piles.

Grade Separations

The 18th and 24th Street separations also provide a structure to carry the San Diego & Arizona Eastern Railway tracks over the two streets. The railroad parallels the freeway and crosses 18th and 24th Streets on 40-foot structural steel plate girder bridges, on reinforced concrete abutments.

Since the grade of the depressed portion of the subways is below ground water level, it became necessary to design for uplift and construct a "boat" section. This involved thickening the base slab, applying membrane waterproofing and installing rubber waterstops at the expansion and construction joints.

This highway was financed by gas tax and federal-aid funds, and was administered by District XI of the Division of Highways. The contractors were the Charles MacClosky Company, R. E. Hazard Construction Company, and C. G. Willis & Sons. W. T. Rhodes was the Resident Engineer for District XI and A. K. Gilbert was the Bridge Department Representative.

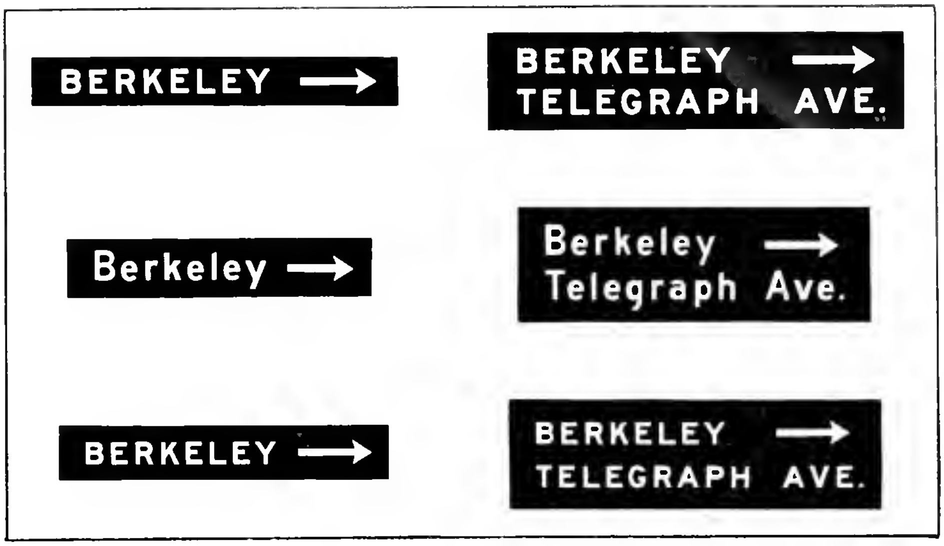


PHOTO 8—Signs of Equal Area—Top, 2 letter-heights per line; middle, 3 loop-heights per line; lower, 2½ letter-heights per line (visibility varies as shown in Figure 8)

Sign Legibility

Continued from page 11 . . .

know how to do them. It was the subjective experience of the authors durings the tests that glance visibility actually exceeded the "stare" visibility which the observers practiced; that is, a word or even a bunch of letters could be read at the first glance, but if near the threshold visibility distance the word would not register, or focus, when stared at.

Estimates of Distances

For rule-of-thumb estimates of distance at which place name signs can be read, the following generalizations of *Figures 3, 4, 5, and 6* are given:

	Distances in feet			
	Lower case per inch of loop height		Capitals per inch of height	
	average observer	near-sighted observers*	average observer	near-sighted observers*
Bright daylight	131	102	114	90
Illuminated, night	95	74	87	69

* Whose reading distance was exceeded by 85 percent of observers.

Acknowledgments

The work was done by members of the Traffic Department, the Materials and Research Department, and the Photographic Laboratory of the Division of Highways as a joint research project with the University of California Institute of Transportation and Traffic Engineering. The Division of Highways activities were under the direction of J. C. Young, Traffic Engineer, and the institute provided the technical guidance of Dr. T. W. Forbes, Visiting Associate Professor of Engineering and Psychology. Individuals making substantial contributions to the progress of the investigation were Carroll Dunham, Robert Monroe, and F. E. Houghton.

Mr. J. E. Penton and Mr. E. E. Radek of the California Metal Enameling Company, 6904 East Slauson Boulevard, Los Angeles, graciously furnished the alphabets used and some valuable guidance relative to spacing of letters. The spacing rules shown in Tables 1 and 2, however, are not the same as those used by the company.

Messrs. Martin O'Brien, F. M. Carter, A. L. Hutchison and Ray Smith of the division, working with the sign company, have all contributed to the letter designs used in California signs.

DEEP FREEZE

Winter weather can make a "deep freeze" of your car, unless it is conditioned for cold-season driving. The lubrication, fuel and electrical systems need special treatment obtainable at reliable service stations.

INDEX TO CALIFORNIA HIGHWAYS AND PUBLIC WORKS

January to December 1950

INDEX OF AUTHORS

Index to Authors—Continued

Bids and Awards

Continued from page 60 . . .

YOLO COUNTY—West Sacramento Freeway, near Sacramento, at Davis Highway Ramp Overcrossing, West Sacramento Underpass, Third Street Underpass, and State Box Overcrossing, four bridges to be constructed and about 0.8 mile of ramps and a detour to be constructed and surfaced with plant-mixed surfacing on crusher run base. District III, Route 6, Section C. Dan Caputo and Edward Keeble, San Jose, $397,208; Granite Construction Co., Watsonville, $414,899; Brighton Sand and Gravel Co., Sacramento, $419,737; Lord and Bishop, Sacramento, $425,016; Charles MacClosky Co. and Harms Brothers, San Francisco, $442,678. Contract awarded to A. Teichert and Son., Inc., Sacramento, $387,780.80.

F. A. S. County Projects

KINGS COUNTY—Across Kings River (Dutch John Cut), about eight miles north of Hanford, a reinforced concrete bridge to be constructed. District VI, Route 568. Thomas Construction Co., Fresno, $68,191; Tumblin Co., Bakersfield, $69,893; Anderson Co., Visalia, $71,125; E. G. Perham, Los Angeles, $72,524; E. H. Peterson and Son, Richmond, $77,222; J. E. Haddock, Ltd., Pasadena, $77,532; Trewhitt-Shields and Fisher, Fresno, $79,524; G. M. Carr and Bati Rocca, Santa Rosa, $83,201. Contract awarded to Charles S. Moore and Robert R. Murdoch, Oakland, $67,255.

KINGS COUNTY—On 10th Avenue between Seventh Street and Grangeville Boulevard and on Laton Highway between Last Chance Ditch and Kings River, about 2.9 miles, portions to be graded and surfaced with plant mixed surfacing and existing pavement to be surfaced and widened with plant-mixed surfacing on the other portions of the project. District VI, Routes 568, 623, 820. Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $77,893; Valley Paving and Construction Co., Inc., Pismo Beach, $80,093; P. J. Moore and Son, North Sacramento, $81,515; Rice Brothers, Inc., Marysville, $84,352; Louis Biasotti and Son, Stockton, $86,701; Gene Richards, Fresno, $88,853; Harms Brothers, Sacramento, $89,018; Volpa Brothers, Fresno, $90,-228. Contract awarded to Ted F. Baun, Fresno, $76,-287.50.

MONTEREY COUNTY—On Carmel Valley Road, near Carmel, between State Route 56 and Robinson Canyon Road, about 5.8 miles to be graded and surfaced with untreated rock surfacing. District V, Route 661. M. W. Brown, Redding, $134,331; Rice Brothers, Inc., Marysville, $134,441; Edward Keeble, San Jose, $141,333; Louis Biasotti and Son, Stockton, $142,978; M. Malfitano and Son, Inc., Pittsburg, $154,561; Clements and Co., Hayward, $158,220; Granite Construction Co., Watsonville, $159,394; Pacific Contracting Corp., Long Beach, $165,157; Eugene G. Alves, Pittsburg, $171,766; Transocean Engr. Corp., San Lorenzo, $175,459; Madonna Construction Co., San Luis Obispo, $177,641; Peter Kiewit Sons Co., Arcadia, $182,520; S. A. E. Co., Redwood City, $183,072; Chittenden and Chittenden, Auburn, $184,893; John Delphia, Patterson, $193,226; John F. Blakemore, El Monte, $197,211; Klein Smid Construction Co., Bakersfield, $198,820; M. J. B. Construction Co., Stockton, $207,205; H. Earl Parker, Inc., Marysville, $210,355; E. Barhettini, San Francisco, $217,613. Contract awarded to Nevada Constructors, Inc., Reno, $127,067.70.

TULARE COUNTY—Lover's Lane, between Federal Aid Secondary 1143 and State Route 10 and Ben Maddox Way, between State Route 10 and State Route 133, about three miles to be graded, surfaced with plant mixed surfacing on cement treated imported base material, and a reinforced concrete bridge to be constructed. District VI, Routes 1137, 1138. Anderson Co., Visalia, $182,753; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $198,972; Louis Biasotti and Son, Stockton, $200,-020; Ted F. Baun, Fresno, $206,715; P. J. Moore and Son, North Sacramento, $218,272; A. Teichert and Son, Inc., Sacramento, $221,995; Harms Brothers, Sacramento, $226,272. Contract awarded to Rice Brothers, Inc., Marysville, $179,935.30.

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director

HIGHWAY COMMISSION

C. H. PURCELL . . . . Chairman
HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego
R. C. KENNEDY, Secretary . . . . . Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
R. M. GILLIS . . . Deputy State Highway Engineer
CHAS. E. WAITE . . Assistant State Highway Engineer
EARL WITHYCOMBE . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
T. E. STANTON . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
E. T. TELFORD . . . . . . Engineer of Design
F. N. HVEEM . . . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
J. P. MURPHY . . . . Principal Highway Engineer
E. J. SALDINE . . . . Principal Highway Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

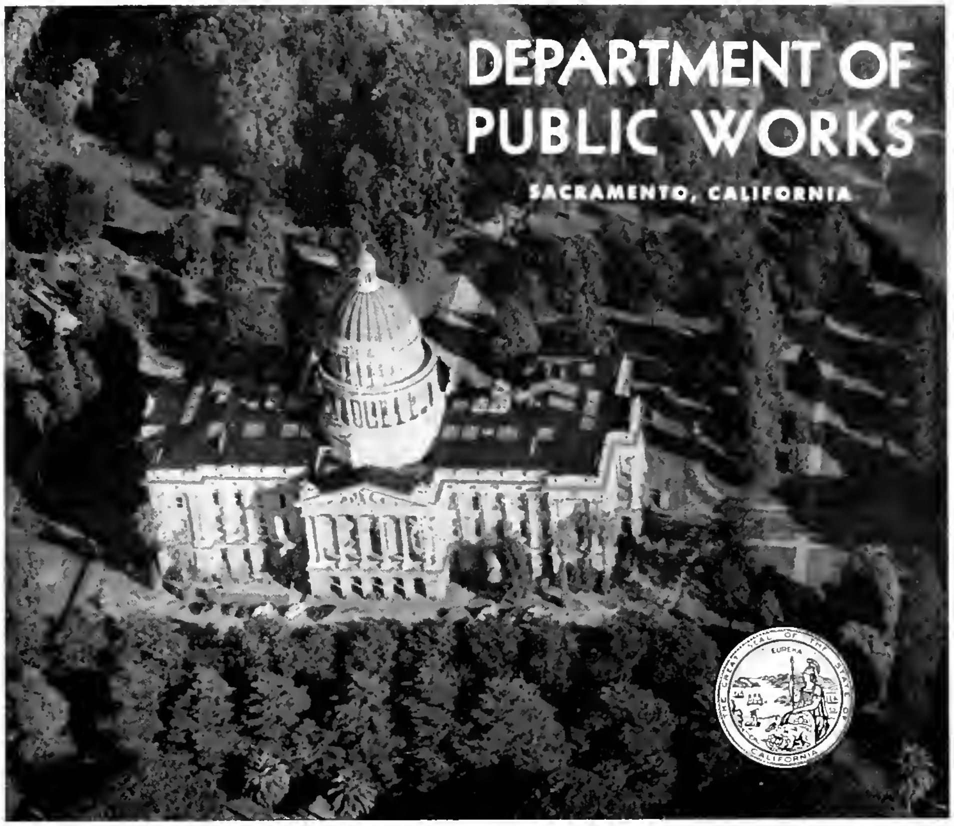
District VII

P. O. HARDING . . Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . District VII, Los Angeles
S. W. LOWDEN . . . District VIII, San Bernardino
ALAN S. HART . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge



DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

RALPH A. TUDOR . . . . Chief Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
HARVEY O. BANKS . Supervising Hydraulic Engineer, Water Pollution Control Investigations
WILLIAM BERRY . Supervising Hydraulic Engineer, California Water Plan
MAX BOOKMAN . . Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
H. S. HUNTER . . . . Deputy Chief
ROBERT W. FORMHALS
Administrative Assistant to State Architect
EARL W. HAMPTON . Supervisor of Contract Architects

Administrative Service

W. K. DANIELS . . . . Assistant State Architect, Administrative
WADE O. HALSTEAD
Principal Estimator of Building Construction
CARLETON PIERSON . . Supervising Contracts Writer

Planning and Design Service

P. T. POAGE . . . . . Assistant State Architect, Design and Planning
A. F. DUDMAN . . . Principal Architectural Designer
CARL A. HENDERLONG
Principal Mechanical and Electrical Engineer
C. L. IVERSON
General Supervising Architectural Draftsman
ELLIOTT ADAMS . . . Architectural Property Analyst
WALTER E. LORD . Supervising Specifications Writer
JAMES A. GILLEM . Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT . . . . Chief Construction Engineer
F. A. JOHNSON . . . Principal Structural Engineer
JOHN S. MOORE . . General Construction Supervisor
NATE W. DOWNES
Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN . . . . . Area I, Oakland
W. H. EPPERSON . . . . . Area II, Sacramento
FRANK R. AUSTGEN . . . . Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD . . . . . . Area I, San Francisco
M. A. EWING . . . . . . Area II, Sacramento
H. W. BOLIN . . . . Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 37211 1-51 29M

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

Seattle Public Library,

Seattle,

Wash.

SEC. 34.66 P. L. & I
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

CALIFORNIA STATE HIGHWAY SYSTEM

Calif. Highway Div

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. BOX 1499
Sacramento, California

Vol. 30 | March-April | Nos. 3, 4

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

Prestressed Bridge

First of Its Kind in State Is Built in Los Angeles

By ROBERT M. BARTON, Associate Bridge Engineer

Successful hoisting of two giant prestressed concrete girders across the Arroyo Seco flood channel in Los Angeles on March 9th-11th marked an important step forward in bridge construction on the Pacific Coast. The bridge, first of its type in the West, makes use of the new engineering principle called "prestressing," said to be one of the most noteworthy advances in concrete construction since the invention of Portland cement.

Attracts Nation-wide Attention

The actual hoisting operations, beginning on Friday, March 9th, and continuing until Sunday night, March 11th, were witnessed by many distinguished engineers from various Southern California points. Motion pictures were taken, and the event was widely reported by newspapers throughout Los Angeles County. The bridge has been the subject of numerous technical articles in such engineering magazines as *Engineering News-Record*, *Civil Engineering*, *American Concrete Institute Journal*, *Western Construction*, and others—in short, its construction has attracted greater technical interest than perhaps any other bridge recently built in California.

The bridge, located in Arroyo Seco Park near the South Pasadena city limits and within sight of the Arroyo Seco Freeway, connects two portions of the park which were previously separated by the flood channel. It carries pedestrians only.

Radical Departure

Nation-wide attention was attracted because the prestressed design is a radical departure from previous types of conventional concrete bridges, such as those recently completed across the new Hollywood, Ramona and Santa Ana freeways. Prestressed concrete, a development of European scientists, is still in its infancy in this Country, and each new bridge constructed is an engineering curiosity. Only two or three prestressed bridges have been constructed previously in the United States, and these are all located east of the Mississippi. However, the general design of the Arroyo Seco bridge involved no significant departures from prestressed structures previously built in Europe, since prestressed pedestrian overcrossings of similar dimensions have been built as long as a decade ago in France.

Arroyo Seco Channel Pedestrian Bridge in Los Angeles. Prestressed girder shown has just been hoisted into final position on abutments. Temporary steel cables on exterior of girder for rigging purposes only.

ABOVE—High-tensile wires with button-heads applied. LEFT—Portable machine used for squeezing button-heads on ends of wires.

Lifting of Huge Girders Unprecedented

The bridge consists essentially of two simply supported girders, each 113 feet long, with a clear span of 110 feet. These two girders, one on each side, support the eight-foot wide pedestrian walkway, and also serve as handrails. These concrete girders were constructed in a parking lot alongside the channel, and were lifted by four giant truck cranes onto their permanent abutments after all prestressing operations had been completed. It is believed the hoisting of girders of this size and weight—each girder weighing over 50 tons—was unprecedented in western bridge construction.

After the two girders were placed on the abutments, the concrete walkway was cast-in-place between them.

Reinforcement Is High-Tensile Wire

The two concrete girders are very similar to conventional concrete in external appearance, but the reinforcement is altogether different. Instead of the deformed mild steel reinforcing bars of about one-inch diameter used in ordinary bridges, the Arroyo Seco girders are each reinforced with 125 high-tensile steel wires, each wire having a diameter of only one-quarter inch. The wires, carried in tunnel-like cavities which extend through the interior of the girders for the full 113-foot length, were tensioned by hydraulic jacks after the concrete had hardened. The total tension which was applied in each girder was 715,000 pounds.

In other words, at the end of each girder there is a force of about 360 tons acting to squeeze it or compress it in the longitudinal direction. (This force is roughly equivalent to the weight of about 200 passenger automobiles.) As a result of this tremendous permanent pressure exerted on the ends of each girder, the entire T-shaped cross section (1 foot 8 inches wide at the top, 10 inches wide at the bottom, and 5 feet 8 inches deep) is placed in a permanent state of compression.

Divided Into Two Groups

The 125 wires in each girder are divided into two groups, one group of 65 wires and one group of 60 wires. Each group is carried in a separate sheet metal enclosure. The groups are arranged into rows of five wires each, each row being connected to a separate steel block for purposes of tensioning. After the wires were threaded through drilled holes in these stressing blocks, their ends were upset to form button-shaped heads. A special portable machine was developed by the prestressing subcontractor to form these heads at the job site.

The wires were stressed five at a time by a specially designed hydraulic jack after the concrete girders had been cast and after the concrete had attained the specified 5,000 psi test cylinder strength. When fully tensioned, the total stretch in each of the wires was five and one-half inches. After the wires had been stressed, steel spacers were placed between the heavy steel anchor plates and the steel stressing blocks to maintain the five and one-half-inch stretch. The jacks were then removed, and the tunnel-like cavities were pressure grouted to bond the wires firmly to the surrounding concrete and to protect them from corrosion.

Since this was the prestressing subcontractor's first bridge job, certain "bugs" developed in his tensioning and wire-heading apparatus. Some of the machine parts had to be redesigned. However, during the course of construction these difficulties were eventually ironed out, and the prestressing method is now regarded as satisfactory by all parties concerned.

Type of Prestressing Equipment Used Optional

Since the principal commonly-used methods of prestressing and of anchoring the wires are subject to patent restrictions, the contract plans were drawn and the special provisions were worded to allow the contractor complete freedom to choose the type of

prestressing equipment and anchorage devices to be used. Thus, all types of prestressing equipment were fully competitive, and this was reflected in lower bid prices.

The amount, diameter, and quality of wire furnished was also more or less optional with the contractor. The principal requirement was that a total prestressing force in each girder of 715,000 pounds, using a working stress of 60 percent of the ultimate wire strength, had to be obtained. Thus, the contractor had the choice of furnishing a large number of very small diameter wires, for a lesser number of larger diameter wires. This also gave him the incentive to furnish wire with a higher ultimate tensile strength, since a lesser amount of such wire would be required than if a wire with a lower tensile strength were supplied. Thus, no one particular proprietary system of prestressing or any one brand of wire was dictated, yet adequate control over materials and workmanship was maintained by the State to insure that a first class structure would result.

Loads and Working Stresses

The bridge was designed for a live load of 55 pounds per square foot on the sidewalk surface.

The maximum working stress for the concrete was 1,700 psi, for concrete with a cylinder strength of 5,000 psi. The 5,000 psi concrete specified was obtained with a standard Division of Highways concrete mix design. Cement content was six sacks per cubic yard, and no admixtures were used. Thus, the concrete used is identical to that employed in numerous highway structures in the Los Angeles area.

The maximum allowable initial stress in the high tensile wires was specified at 0.6 of the ultimate strength. The contractor elected to furnish a wire with an ultimate tensile strength of 220,000 psi, the allowable working stress in which case being 132,000 psi. However, since this is an experimental structure, the contractor decided to restrict his initial stresses to 120,000 psi, or less than 6,000 pounds in each individual wire.

Allowances were made in the design for a total loss of the initial prestress in the wire of 15 percent, due to shrinkage creep, plastic flow, and other

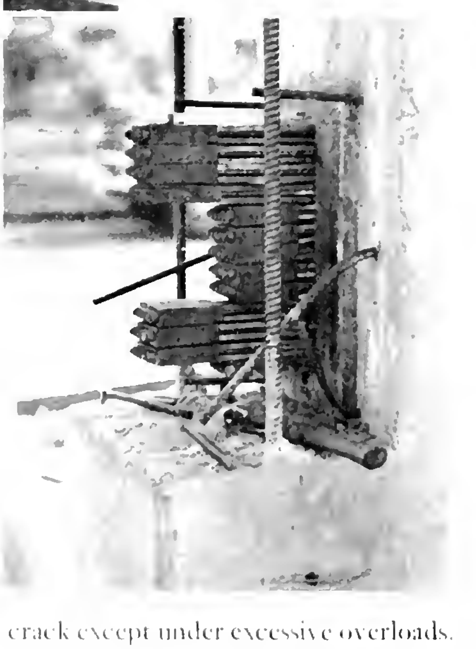
ABOVE—Interior of girder form, showing sheet metal cable enclosures, before sides of form brought together. RIGHT—Resident Engineer Jack Sylvester holding leads to Carlson electrical resistance strain gages. Note sheet metal enclosures built around wire cable groups in lower part of beam to form tunnel-like cavities.

causes. Thus, the initial prestress of 120,000 psi in the wire will gradually decrease to 102,000 psi over a period of time.

Differences Between Conventional Concrete and Prestressed

There is little similarity between conventional reinforced concrete and prestressed concrete. Since plain concrete that is not reinforced has little tensile strength, it must be reinforced by steel bars embedded in the lower portions of the beam to enable long distances to be spanned. Until the falsework is removed and the beam is loaded, these bars are not subjected to any stress. As a conventional concrete beam is loaded progressively, the concrete in the bottom of the beam reaches the tensile strength limit and cracks. As soon as the cracks occur, the load is transferred to the steel reinforcement, and the steel stretches gradually as it assumes its share of the load. This time-honored system has proved highly satisfactory; the countless concrete bridges and buildings to be seen everywhere are designed in accordance with this principle, although sometimes the cracks mentioned become quite obvious and cause concern to persons who do not understand their function.

In a prestressed beam, on the other hand, the steel is placed in tension and stretched to its working stress before the beam is subjected to either dead load or highway loads. The concrete is thereby compressed, and under ordinary highway traffic loading this compression remains permanently in the concrete. Consequently, it does not



TOP—General view of prestressing equipment; stressing jack in operation. MIDDLE—Hydraulic wire-stretching jack in operation. Tensioning of wires in left girder has been completed. BOTTOM—Each protruding stressing block anchors five wires which have been fully tensioned. Rows not protruding are not yet tensioned. Note steel spacers to hold stretch.

crack except under excessive overloads. If cracks do occur, they close up again as soon as the overload is removed.

To understand how a prestressed concrete girder functions, it is helpful to imagine a shelf of library books. By pressing firmly on the ends of the row of books, they can be lifted from the shelf. However, if this external pressure is released, the books all fall to the floor. A prestressed concrete bridge acts exactly like a shelf of books; in fact, some prestressed bridges are actually made of separate concrete blocks, analogous to the individual books.

Prestressing Permits Savings

One of the advantages of prestressed concrete as compared to ordinary concrete is that the prestressed material is much more efficient, since all of the concrete assists in supporting loads. In ordinary girders, the concrete is only partially effective for supporting highway traffic. Because of the more effective use of concrete, less material is required when prestressing is utilized.

As an illustration of this saving, a conventional reinforced concrete bridge of approximately the same span was designed for the Arroyo Seco site prior to World War II. Due to shortages of material, construction was deferred until after the war. It was then decided to experiment with the prestressed design.

The following tabulation shows a comparison of the amounts of material required for the girders of the two different designs:

	Conventional design	Prestressed design
Cubic yards concrete	88	50
Pounds steel wire (hi-tensile)	.....	5,000
Pounds reinforcing steel	40,000	7,000
Total steel (pounds)	40,000	12,000

It should be emphasized that no attempt was made in the design of the prestressed structure to achieve the ultimate economy of material theoretically possible. Although a smaller concrete section with less dead load and requiring less steel wire and concrete could have been used, it was considered more practical to experiment with a cross-section which would not involve unusual types of formwork, and which would not entail unusual difficulty in the placing of the concrete. It is hoped, however, that as a result of the many valuable lessons gained from the pioneer Arroyo Seco structure, further economies in material requirements may be made.

Accurate Cost Comparison

Although the original design was never built, bids submitted by contractors on similar types of work permit a reasonably accurate cost comparison to be made between the two types of construction. This comparison indicated the contract cost of the prestressed structure was approximately the same as the conventional structure would have been. However, as contractors gain further experience with

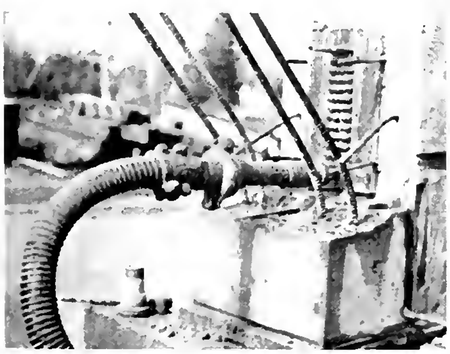
of steel may become important if supplies of iron and steel earmarked for highway purposes are curtailed by defense allocation authorities.

However, the Arroyo Seco Bridge is an experimental project, and it is expected certain refinements will be necessary in the prestressing technique before it can be applied for general highway use.

Downstream girder being hoisted onto abutments; upstream girder still in parking lot in background

prestressing, it is believed prestressed concrete will prove less expensive than conventional reinforced concrete.

Nozzle used to force grout into interior of cable enclosures at anchor end of girder after prestressing completed



Also prestressed girders may be shallower, lighter, and stiffer and still carry the same load as deeper, heavier, more flexible girders of conventional design. For this reason prestressed concrete appears to be ideally suited for use on freeway separations where overhead clearance limitations are a primary consideration.

Prestressed Concrete May Be Answer to Steel Shortage

Prestressed concrete was originated in Europe, where the conservation of scare steel supplies is of utmost importance. European engineers discovered that prestressed concrete required only a fraction of the reinforcing steel needed for conventional concrete. In this country, this saving

Girders Precast

As has been described, the Arroyo Seco girders for the bridge were built in a nearby parking lot, and were then hoisted across the channel. This is another important advantage of the lighter prestressed design, since bridge girders can be constructed at a convenient location and then hauled to the job site. It was not necessary to erect the usual temporary timber falsework across the channel to support the concrete while it was being placed. Furthermore, only one set of wooden forms was required for the two girders, the one set being used twice. These two features—the elimination of falsework and the 50 percent saving in formwork—saved an estimated \$5,000 on this project.

Also, all possible risk and delay from floods was avoided by casting the girders in the parking lot. Regulations of the Los Angeles County Flood Control District prohibit falsework in Arroyo Seco Channel during the winter and spring. Consequently, construction of the bridge would have been delayed several months if precasting, made possible by prestressing, had not been practicable.

Bridge to Be Tested

A pedestrian bridge was chosen for the initial prestressing venture primarily because experiments can be carried out safely, conveniently, and without delay to vehicular traffic. In addition, there is little hazard a pedestrian bridge will be subjected to unregulated loads that greatly exceed the design live load; a vehicular structure, on the other hand, often carries illegal overloads of fantastic weight. Also, this type of bridge allowed the engineers to observe the practical problems and difficulties connected with prestressing and erecting long bridge girders.

. . . Continued on page 28

Gaviota Pass

Historical Landmark Will Be Preserved by Highway Engineers

View of Gaviota Gorge looking south. The natural beauty will be maintained by boring through the massive sandstone ledge and minimizing the removal of surface rock.

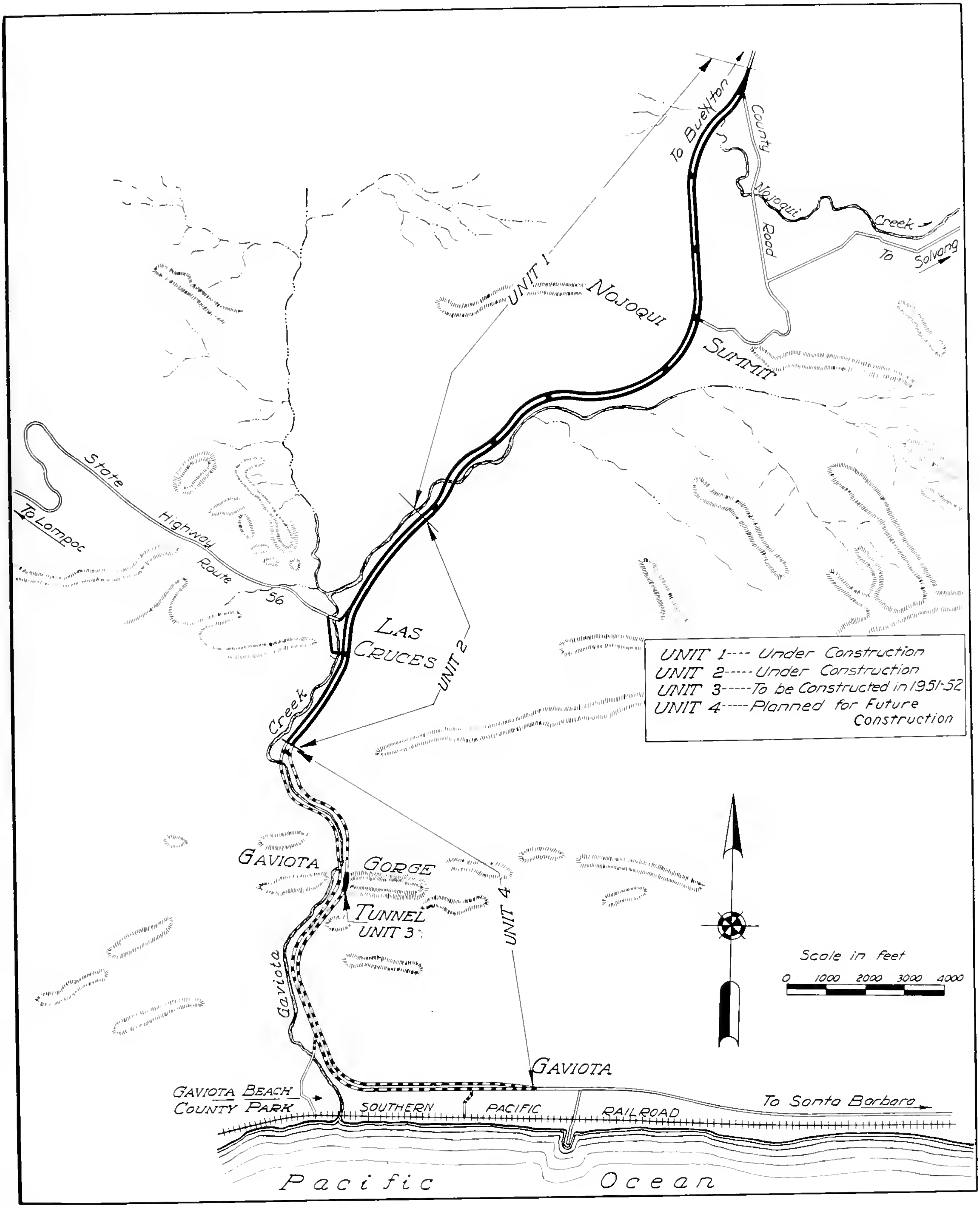
TWO CONTRACTS for an additional two lanes of U. S. 101 covering the 5.14-mile section between Gaviota Gorge, originally called Gaviota Pass, where in December, 1846, General John C. Fremont and his battalion of 500 men marching on Santa Barbara narrowly escaped annihilation, and one mile north of Nojoqui Summit are actively under way.

Plans are complete and early construction is anticipated on a tunnel through the narrowest portion of the gorge; and plans for the construction of the final unit of this new four-lane divided highway, which will start south of the town of Gaviota and join with the present construction at the north end of the gorge proper, are nearing completion.

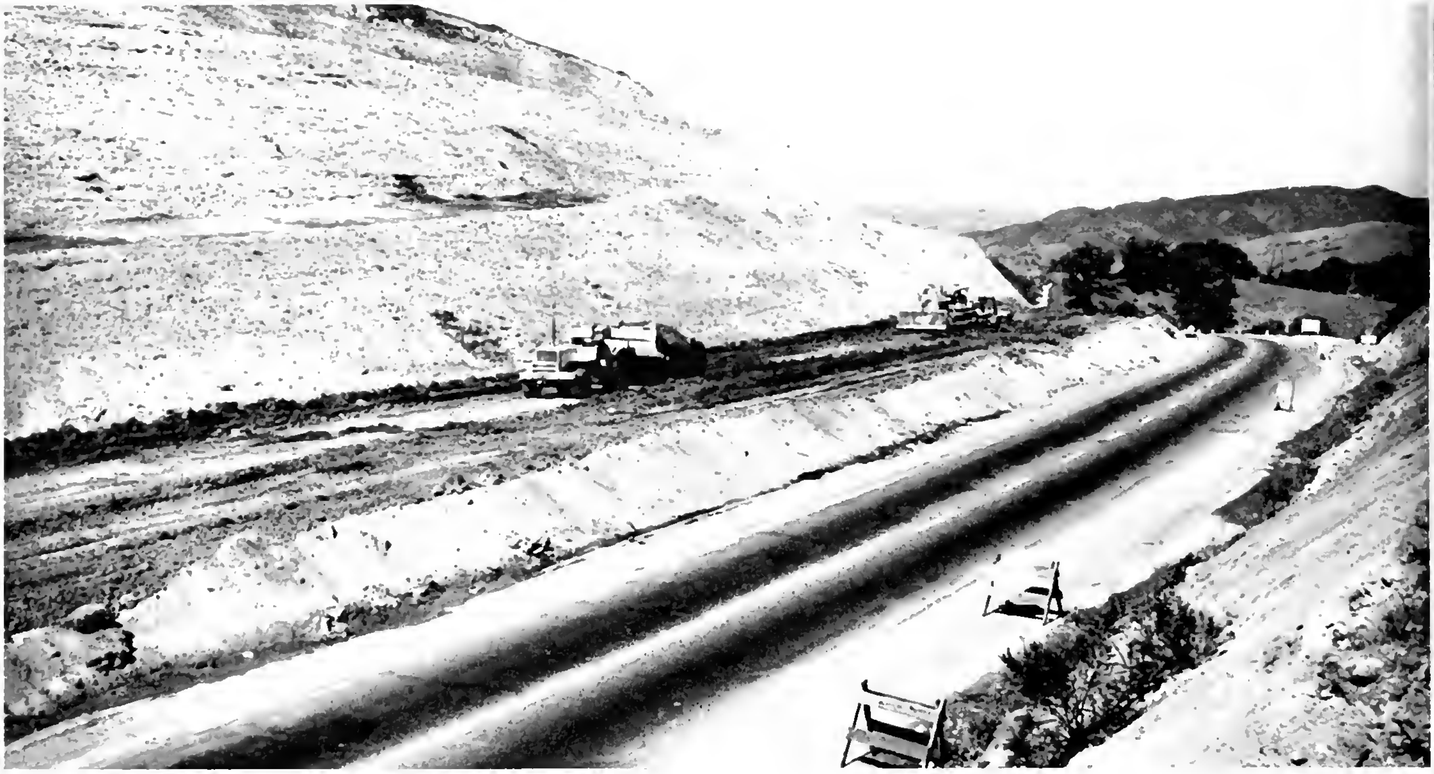
When completed the four-lane freeway through this historical section of Santa Barbara County will be about 8.2 miles in length and construction costs will approximate $3,000,000.

Tunnel construction through the narrowest portion of the gorge was decided upon so that the natural scenic beauty of this historical landmark could be preserved. When the project is completed the two existing lanes through the gorge will carry southbound traffic, and northbound traffic will use the two lanes through the tunnel. From Gaviota Gorge to Nojoqui Summit, now known as Gaviota Pass, improvement will be on freeway standards.

The 1951-52 highway budget has set up $420,000 for tunnel construction.



To Buellton
County Nojoqui Road
Nojoqui Creek
To Solvang
UNIT 1
NOJOQUI SUMMIT
State Highway Route 56
To Lompoc
LAS CRUCES
UNIT 2
Creek
UNIT 1---- Under Construction
UNIT 2----- Under Construction
UNIT 3----- To be Constructed in 1951-52
UNIT 4----- Planned for Future Construction
GAVIOTA GORGE
TUNNEL UNIT 3
UNIT 4
Gaviota
Scale in feet
0 1000 2000 3000 4000
GAVIOTA
GAVIOTA BEACH COUNTY PARK
SOUTHERN PACIFIC RAILROAD
To Santa Barbara
Pacific Ocean



Grading operations in progress at Najaqui Summit. The view is looking north with the Santa Ynez Valley in the distance.

En route to Santa Barbara where he expected to do battle with the Californians, Fremont encamped on the Rancho Tinaquaic, near what is now the town of Los Olivos, owned by Benjamin Foxen, an Englishman by birth, who had married Senorita Eduarda Osuna. Fremont and Foxen became friends. Allied by marriage to the Californians, Foxen had taken no part in the war for California.

One night in late December, 1846, Fremont confided to his friend that he proposed to march on Santa Barbara.

"By way of Gaviota we can be in Santa Barbara in two days," Fremont said.

Foxen was disturbed. He knew that he would be considered a traitor by his wife's people if he aided Fremont. He was aware that the Californians had massed at Gaviota planning to trap Fremont in the narrow defile. They planned to blast down tons of rock, closing both ends of the pass, after Fremont and his men had entered it and then slaughter them.

The Englishman suddenly made up his mind. He warned Fremont that he could not get through Gaviota. He offered to guide him over San Marcos Pass by a trail known only to himself. This he and his son, Guillermo, did. The Californians, confident of success, waited at Gaviota.

On December 27th, Fremont and his battalion marched into a deserted Santa Barbara and captured it without bloodshed. As Foxen had predicted, the male population was assembled with arms at Gaviota Pass.

Somewhere offshore two British men-of-war were heading for Santa Barbara, and historians say that negotiations had been entered into between the Californian leaders and the English for the surrender of Santa Barbara and California. It is difficult to overestimate the disaster to American ambitions that would have resulted had Fremont and his men been annihilated in Gaviota Pass.

Of the many thousands of motorists that each year travel over El Camino Real, the Coast Highway between San Francisco and Los Angeles, and the San Marcos Highway, few give a thought to the historical importance of Gaviota Gorge, "The Pass of the Gulls," and of San Marcos Pass, which was the salvation of Fremont and, perhaps, of California.

Fewer still realize that a few miles from these two great roads is the little gray church of Sisquoc and its cemetery where rest Benjamin Foxen and many of his kinsfolk and friends of long ago, and that nearby is a monument of enduring granite erected in honor of the memory of General Fremont and Foxen.

UPPER—Nojoqui Grade showing inadequacy of existing roadway. The new four-lane highway which will be developed from existing two-lane highway will eliminate hazardous conditions on this grade. LOWER—Construction operations in progress on Nojoqui Grade just south of the summit.

UPPER Bridge over Gaviota Creek at Gaviota Gorge. Existing lanes will be retained as southbound lanes. The tunnel will be through sandstone ledge at left.

LOWER View of Gaviota Gorge looking north. South portal of tunnel will be just beyond trees to right of center.

Harbor Freeway

Progress Report on Multi-Million Dollar Project in Los Angeles

By P. O. HARDING, Assistant State Highway Engineer

HARBOR Freeway, in Los Angeles, as a southerly extension of the Arroyo Seco Parkway, had its inception over 20 years ago when governmental organizations and civic minded people in the Los Angeles area recognized the need for a new traffic artery connecting the downtown business area of the city with the San Pedro Harbor district. The first publications which carried maps indicating the Harbor Freeway, designated the portion of it going around the main downtown business district as the "West Bypass." This location was shown as being a short distance westerly of Figueroa Street, which is the location now generally followed by the part of the Harbor Freeway as designed between Temple Street and 23d Street.

Figueroa Street, which is present State Highway Route 165, is a very important traffic artery, but for many years it has become so badly congested because of heavy traffic and the business development of the street frontage that its efficiency as a traffic carrier has been greatly reduced. From 23d Street southerly to 190th Street, the location of the Harbor Freeway is on the easterly side of Figueroa Street. From 190th Street to the southerly end of Figueroa Street at the intersection with Wilmington-San Pedro Road, the Harbor Freeway location is on the westerly side of Figueroa Street and it follows along the west side of Wilmington-San Pedro Road to a connection with Gaffey Street at Battery Street in the San Pedro district.

Six to Eight Lanes

Design of the Harbor Freeway is going forward on the basis of providing six lanes or eight lanes for the freeway traffic. Traffic studies indicate that eight lanes will be needed from Slauson Avenue northerly and that six lanes will be required from that point southerly. For the northerly portion of the Harbor Freeway, adjoining the downtown Los Angeles business area, collecting and distributing roadways are necessary part way on both sides and a comprehensive system of on and off ramps is required. These have been designed on the basis of making most of the Los Angeles city east and west cross streets between Temple Street and Olympic Boulevard one-way streets. As of the present time two of these streets, Fifth and Sixth Streets, are operating as one-way streets with considerable success. It is anticipated that other streets in this vicinity will be made one-way streets before this portion of the Harbor Freeway has been completed. In any event, it will be necessary for one-way street operation to be put into effect as planned at the time the freeway has been completed and opened to traffic.

Freeway Agreements

Freeway agreements covering the entire length of the Harbor Freeway have been entered into between the City of Los Angeles, the County of Los Angeles, and the State. Prior to the execution of these freeway agreements, considerable opposition arose on the part of groups of affected property owners to some sections of the proposed location for the Harbor Freeway, and figures were released to the local press showing fantastic numbers for the homes and families that would be interfered with by the freeway construction. By actual count, it was determined that the following were the facts of the situation as to buildings and families interfered with for the portion of the Harbor Freeway from Olympic Boulevard in the City of Los Angeles to Battery Street in the San Pedro district of the Los Angeles Harbor:

Commercial buildings	140
Residential buildings	2,643
Total buildings	2,783
Total number of families	5,402

Public hearings relative to the Harbor Freeway have been held locally by the City Council of the City of Los Angeles and in Sacramento by the State Highway Commission.

Right of Way Acquisition by State

Members of the District VII Right of Way Staff are actively engaged in right of way acquisition for the Harbor Freeway from Temple Street southerly to Exposition Boulevard. Between Temple Street and Olympic Boulevard, the most northerly mile and a half section where active construction is under way, about 95 percent of the property required for construction has been obtained and cleared. For the most part, the private property needed for freeway right of way has been obtained by negotiation. In very few instances has it been necessary for the State to proceed with eminent domain proceedings in order to acquire property that is needed.

One of the condemnation suits that had to be initiated by the State involved a large holding that was operated as a miniature golf course. The State originally offered \$283,000 to the owners of this property, who were asking \$600,000. After a 23-day trial, the award was \$278,608.75. The results of this condemnation trial, with the award being less than the State's offer, indicated that the State's methods of appraisal of property to determine its fair market value were just and fair to the property owners.

Statler Center Hotel Affects Traffic Pattern

The Statler Center Hotel project, just east of the Harbor Freeway between Wilshire Boulevard and Seventh Street, is of great importance to the City of Los Angeles and has a very considerable effect on the traffic pattern of the Harbor Freeway because of its proximity thereto. The construction work on this hotel was started July 5, 1950. The contractor is Robert E. McKee of Los Angeles, the same contractor as constructed the District VII State Division of Highways Building.

The estimated cost of construction is $20,000,000, and the date for completion is June, 1952. In this hotel, 1,275 guest rooms are planned and there will be 70,000 square feet of floor space available for shops.

The future effect of traffic concentrations in this vicinity by reason of the hotel operation has been studied, and the construction designs for the Harbor Freeway with its system of distributor roads and traffic interchange ramps and the reconstruction of existing city street layouts have been worked out taking this feature into account.

Fourth Street Tunnel, a Los Angeles City Project

Fourth Street is now a discontinuous east and west street because of the steep hill easterly of the Harbor Freeway between Flower Street and Olive Street. In order that the Harbor Freeway may function efficiently in picking up and distributing traffic to and from the Los Angeles downtown area, it is necessary that Fourth Street be developed as a through traffic artery for one-way eastbound traffic. The Los Angeles City Council recently took action approving the City Engineer's design for this proposed tunnel, with the easterly portal just west of Olive Street and the westerly portal half way between Flower Street and Hope Street. This tunnel is planned 850 feet long, with a 50-foot bore, providing a 43-foot width of roadway, with one 5-foot sidewalk for pedestrians. The westerly end of the tunnel will connect with the viaduct planned to carry eastbound Fourth Street traffic and traffic from the Harbor Freeway off ramps over Flower Street and Figueroa Street.

The estimated cost of the tunnel construction is $3,000,000, and steps are now being taken by the city authorities to provide necessary funds so that this project can be advertised for construction very soon. It is anticipated that the completion date will be sometime during 1953.

Design in Progress

Design of plans for construction of the Harbor Freeway is under way in three different locations. In the Sacramento office of the Bridge Department, detailed design plans are in progress for grade separation structures and also the heavy retaining walls that are required in freeway construction. Designs for reconstruction of city facilities such as for reconstruction of existing city streets, street lighting systems, sanitary sewers and storm drains, are being prepared in the office of the Los Angeles City Engineer. District VII is responsible for the over-all planning of the Harbor Freeway, for the acquiring of all rights of way, for the coordination of the design work being done by other agencies, and for preparing the detailed contract plans for all road work. The wholehearted cooperation which the State Division of Highways has had

Looking northerly showing Harbor Freeway construction with steel in place for bridge deck of Third Street overcrossing grade separation in front foreground. The curving ramp bridge for traffic entering the Harbor Freeway southbound is shown in middle foreground. In background to the left is the four-level grade separation.

View from Temple Street looking southerly along cleared right of way for Harbor Freeway showing in middle foreground completed First Street and Second Street underpass grade separation bridges. The city street to the left is Fremont Avenue and in the background is the steel framework of the Statler Center Hotel.

from the staff of the Los Angeles City Engineer's Office engaged in the preparation of freeway designs, has resulted in early advertising and awarding of construction contracts on the Harbor Freeway.

The design work on the Harbor Freeway has been substantially completed between Temple Street and Olympic Boulevard. Design work is currently under way between Olympic Boulevard and Exposition Boulevard, and at the southerly end from Battery Street to Lomita Boulevard. It is very important that designs be worked out and right of way acquisition started for the southerly portion of the Harbor Freeway, which is through relatively open country, as quickly as possible before further development of private property takes place.

Construction Completed and in Progress

The November-December 1949 issue of *California Highways and Public Works* on pages 52 and 53 carries illustrations of the proposed Harbor Freeway that were prepared by Mr. Van der Goes of the Sacramento office of the Bridge Department. These perspective drawings show the portion of the Harbor Freeway upon which active construction is now in progress under state highway contracts and the completed construction at the northerly end where the Harbor Freeway intersects the Hollywood Freeway at the four-level grade separation structures.

The three bridges comprising the Temple Street undercrossing of the Harbor Freeway and two interchange roadways were completed December 22, 1948, at a cost of $382,000. The contractor on these bridges was James I. Barnes Construction Company.

The undercrossing bridges at First Street and Second Street were completed January 18, 1951, at a cost of $450,000. Oberg Brothers were the contractors.

The two overcrossing bridges at Third Street, contractor Charles MacClosky, are 75 percent complete. The contract allotment is $339,000.

The Fourth Street overcrossing bridge, W. J. Disteli, contractor, is 35 percent complete. The contract allotment is $545,500.

The two overcrossing bridges at Fifth Street and Sixth Street, Winston Bros. Company, contractors, contract allotment $1,010,800, are 10 percent complete. This contract was awarded December 8, 1950.

A contract has recently been awarded to Webb & White of Los Angeles, for the construction of an overcrossing bridge at Wilshire Boulevard. The contract allotment is $380,000.

Multi-Million Dollar Project

The sum total of construction work on the Harbor Freeway, completed and in progress, is $3,107,300. This latter figure does not include any of the $1,500,000 which was the cost of the four-level grade separation structure at the intersection of the Harbor Freeway with the Hollywood Freeway and the Arroyo Seco Parkway.

The Harbor Freeway, from its northerly terminus at its intersection with the Hollywood Freeway at the four-level grade separation structure to

. . . Continued on page 24

Factual Studies *Indicate No Damages From Property Access Restrictions*

By W. S. YOUNG, Headquarters Right of Way Agent

The problem of estimating the value of access rights to the through lanes of traffic for commercial properties results in greater variances of opinions among appraisers than any other type of valuation estimate. Fundamentally, the value of any property, like any other commodity, is contingent upon the relationship of the supply to the demand. Likewise, the value of any right in the ownership of real property is contingent upon the effect of the removal of this right upon the relationship of the supply and demand for this type of property when placed in competition on the open market with properties still retaining the particular property right being restricted or acquired.

Since access rights are regarded as a property right which may affect the value of the total remaining property rights when exposed for sale on the open market, the measure of the value of this right of access is recognized as being the difference between the amount which reasonably might be received for the property, including all the rights, and the amount which might be received for the property after the access rights have been limited as proposed.

Test of Value of Access Rights

The test of the value of access rights logically may best be applied by reference to similar properties which have been sold on the open market prior to the acquisition of their access rights and again following restriction of the access rights.

Since the construction of highways to which abutting properties have only limited or no rights of access is relatively new, examples of properties which qualify under this ideal test are very limited. However, inasmuch as the amount of business transacted—in other words, the earning power—is one of the principal factors in determining the relationship of the demand to the supply, a comparison of the amount of business transacted previous to the limitation of access rights to the volume of business transacted following restriction of these rights obviously is an accurate indicator of whether or not payment should be paid for the limitation of direct access to a business property.

Following in line with this reasoning, the Division of Highways has analyzed the sales tax returns of some 20 highway businesses in two locations where access to the through lanes of traffic have been eliminated by placing these businesses on frontage roads.

MILK FARM

One of these roadside business developments is located approximately 20 miles westerly of Sacramento on U. S. Highway 40 and includes three businesses, the best known of which is the Henderson Milk Farm Restaurant, operating on the frontage road having more than 1,500 feet between openings to the main traffic lanes.

These businesses, which include a service station and a soft drink stand in addition to the Milk Farm Restaurant, operated for several years with unlimited access to traffic in both directions. Since November of 1948 their patrons have enjoyed the safety and attractiveness of a chain link fence and planting strip which separate the highway from the frontage road the full 1,500 feet between the access openings.

Shortly after opening of the frontage road, Mr. Henderson, owner of the Milk Farm Restaurant, addressed a letter * to Mr. G. T. McCoy, State Highway Engineer, expressing his complete satisfaction with, and appreciation of the many benefits of operating somewhat removed from the main traveled lanes. This letter was written at a time when all the competitive establishments along this section of U. S. Highway 40 between Sacramento and the Bay area had unlimited access from the main traveled lanes.

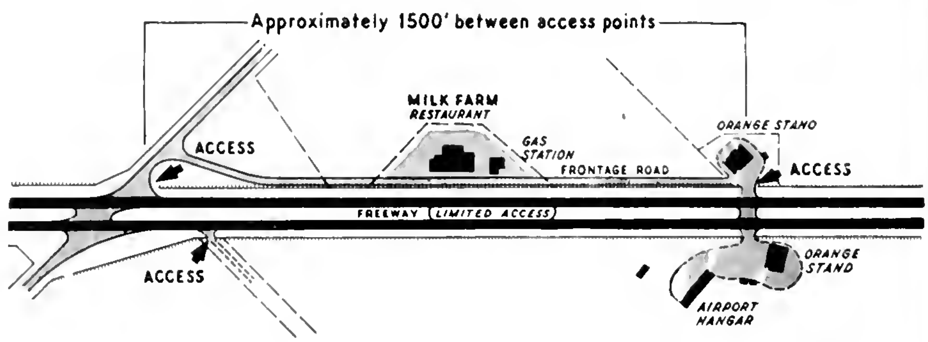
No Adverse Effects

The approximately two years of elapsed time since the opening of the frontage road to traffic has enabled us to make a before and after comparison of the retail business volume of the Milk Farm Restaurant to the business volume of the five other first class restaurants situated on this highway between Sacramento and Vallejo. This comparison has indicated that the judicious limiting of access to this highway business did not have any adverse effects.

Comparing the business volume of the Milk Farm during the year following its being placed on a frontage road to its business volume of the year immediately preceding this arrangement, we find that the restaurant enjoyed a

* See January-February, 1949, issue of *California Highways and Public Works.*

This engineering sketch illustrates the type of success enjoyed by the restaurant, service station and soft drink stand which were moved back to abut upon a frontage road on U. S. Highway 40 near Dixon, California



25.1 percent gross increase. During this same period the five other first-class restaurants along this section of highway, while having unlimited access to the through lanes of traffic, realized only an average increase of 9.3 percent.

Service Station Benefits

Further evidence that access restriction at this location did not damage business is found in the comparison of business volume transacted by the service station also located on this frontage road. During the year following the moving back of the service station from the through lanes, the service station disclosed an increase of 17.7 percent in retail business. Gasoline gallonage increased 5 percent over a comparable preceding period. Like Mr. Henderson, owner of the restaurant, Mr. Higby and Mr. Clark, operators of the service station, have acclaimed the benefits of the frontage road location.

While service station business at this location was on the increase, service stations throughout Solano County average a decrease of approximately 9 percent.

The third business operating on the frontage road, an orange drink stand owned by Mr. Ballinger for several years, enjoyed an 8.5 percent increase in business volume.

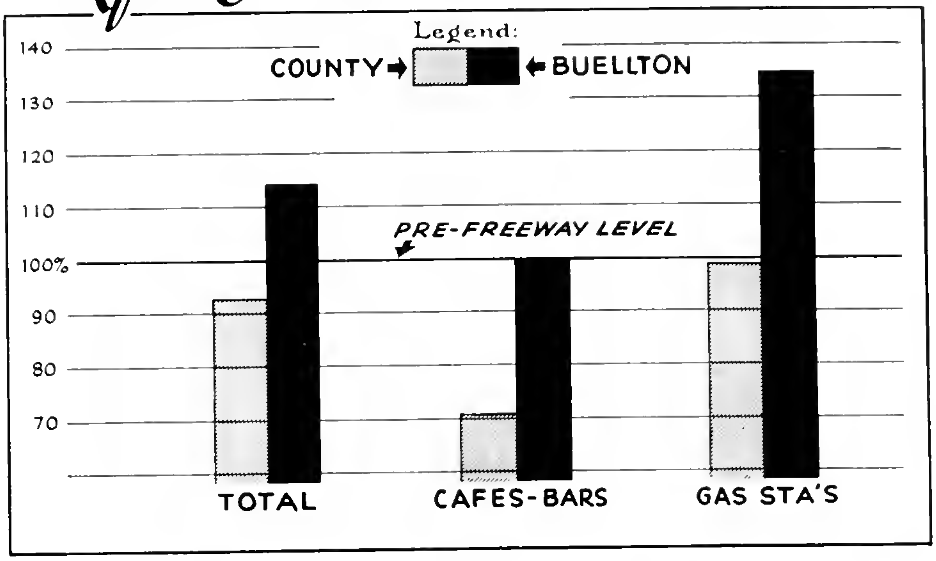
Although there have been no before and after real estate transactions along this section of frontage road, this has been because the property was not for sale. Offers well above the appraised value of the property at the time it had unlimited access to the highway have been refused.

BUELLTON

Another well-known frontage road development where retail business comparisons clearly indicate no adverse effects resulting from the limitation of access rights to commercial properties is the town of Buellton, located about 44 miles north of Santa Barbara on the Los Angeles to San Francisco section of U. S. Highway 101. This is another example of a location where businesses formerly afforded unlimited access to the main traveled lanes were moved back to abut upon a frontage road with no direct access.

In this town of approximately 250 inhabitants, depending almost entirely upon the support of highway patronage, all types of roadside businesses enjoyed substantial benefits through the alleviation of congestion and the increased safety to customers.

BUSINESS VOLUME CHANGE *After* FREEWAY OPENING



Graphic comparison of retail business volume by type in Buellton to Santa Barbara County businesses during the year after the Buellton businesses began operating on a frontage road

The nine service stations located along this section of frontage road average an increase of 34 percent in volume of retail business above the last year in which they enjoyed unlimited access. This was during the period when service stations throughout Santa Barbara County suffered a decrease of 11 percent in volume.

Buellton Restaurants Helped

The three restaurants in Buellton averaged a 0.2 percent increase, while Santa Barbara County restaurants dropped off 23 percent.

The comparison of over-all business volume in Buellton to Santa Barbara County business volume indicates the increasing popularity of this roadside development along a frontage road. Buellton business averaged an increase of 14 percent following completion of the highway improvement, while retail business generally in Santa Barbara County suffered a decline of 7.3 percent.

Like the foregoing Solano County frontage road development, no before and after sales of the same property were registered in Buellton. However, here also the accepted front foot value has increased approximately five times over the previous existing values. Assessed values of the land have increased approximately 350 percent.

While increased retail business volume at a given location unquestionably results in greater values in the subject properties because of an immediate increase in demand, actual examples of before and after sales of properties where access rights have been restricted provide us with the best evidence of the lack of damages resulting from judicious access restrictions to commercial developments.

HOTELS

An analysis of the histories of two motel properties located near the northerly end of the North Sacramento Freeway on U. S. Highway 99E and 40, delineates for us the effects of placing these businesses on a frontage road at a time when competitive businesses along the same section have unrestricted access.

Inasmuch as the highway requirements from one of these properties were acquired in condemnation, this analysis suggests that the lack of factual data concerning the effects of access restriction is costing California taxpayers a considerable sum of money in unmerited damage payments. In the

View of the frontage road facilities at the northeasterly end of the North Sacramento Freeway along which are situated the two motel properties discussed herein

case of these properties also, a frontage road having more than 1,500 feet between openings was provided to link them with the through lanes of traffic.

North Sacramento Freeway

The North Sacramento Freeway was completed in the fall of 1947, but the right of way acquisition from the two subject motel properties was not completed until 1948, at which time both were operating along the frontage road. By this time the motel business throughout the State had dropped off drastically from the 1947 high as a result of the tremendous increase in number of units thrown on the market by new construction and premiums above the cost of new construction were seldom being paid for operating motels.

One of these motels, several years old and consisting of 20 units and living quarters for the operator, was purchased in December of 1946 for $88,000, which was above the estimated replacement cost new at that time. The land consisted of a 220-foot frontage by a 453-foot depth, the motel being constructed on the westerly 110 feet of the property.

The State's right of way requirements were the access rights to the freeway and a 40-foot strip off the front of the property needed for the construction of a frontage road adjacent to the freeway and serving four existing motels and several vacant properties.

Because no agreement could be reached between the State and the property owner as to the amount of damages due to the access restriction, the matter was settled in a condemnation trial in May of 1948. The court award was $25,000 for damages to the remaining property.

Court Awards

This award of $25,000 damages influenced the settlement by stipulation of a pending litigation on a neighboring motel property on the same frontage road. The amount of damages paid in this latter transaction was $9,000.

Both these motels were sold in the latter part of 1950, having been in operation with access to the freeway by means of the frontage road since 1947 in competition with many other motels along the same highway with access as yet unlimited.

Despite the lack of direct access to the highway, and despite the fact that sales of motels in the Sacramento vicinity generally have indicated a downward trend in values of approximately 20 percent during the past five years, or an average depreciation of 4 percent per year, the 20-unit motel abutting the North Sacramento Freeway brought a price of $85,000 in October of 1950. This sale included only one-half of the land obtained in the 1946 purchase price of $88,000. By adding the $10,000 accepted fair market value of the remaining 110-front feet of vacant property (now listed for sale at $16,000) to the $85,000 received for the motel, we find there was a net gain in total valuation amounting to $7,000. The land values of this frontage have doubled since construction of the freeway.

Values Increased

Further emphasizing the costly lack of factual data on access limitation effects is the history of the other motel which sold in 1950 after doing business for approximately four years on the frontage road.

This motel was built by the individual who owned it at the time of the state right of way acquisition, hence no previous selling price was available. Also, since the operator performed most of the construction work himself, no actual building costs for it are available.

The five-year-old masonry motel, which contains 10 units and living quarters for the operator and has 150 feet of frontage, sold for $52,500. This amount also is greater than the estimated replacement cost new of the property at the time of the freeway construction.

An analysis of this sale after verification by the buyer and seller indicates a land value of $13,635 at the rate of $90.90 per front foot, furnishings valued at $2,500 and the building improvements valued at $36,356, which is approximately $3,636 net per unit. This value per unit was found to be somewhat above average values per unit being obtained for first-class motels in the market in this vicinity.

The fact that land values along the frontage road are commonly accepted as being more than double the same land values existing prior to the freeway construction and considerably greater than nearby highway frontage where access has not been as yet restricted establishes that none of the properties were damaged by the limitation of their access rights, as reflected in the real estate market. The commercial highest and best use at this location has remained constant for several years.

CONCLUSIONS

The foregoing analysis of these commercial properties whose access rights have been restricted by placing them on frontage roads leads us to the conclusion that the means of access to a commercial property from a highway frequently is grossly over-weighted in comparison to the many other factors contributing to the success or failure of a highway business venture.

The several distinct advantages of frontage road service for commercial enterprises, coupled with progressive merchandising practices, have more than offset any detrimental effects of circuity of travel.

These advantages include: safer, unhurried entrance to the property; improved attractiveness inherent in a uniform setback; and greatly extended economic lives of the commercial enterprises because of the guaranteed permanency of freeway construction. In the case of the motel properties, being farther removed from highway noises has proved a much commented on advantage.

Apparently because of the discovery of the many advantages to the motorist, these frontage road developments have found their already high repeat customer business to be on the increase.

In considering the progress of highway development and the resulting trends in highway users' habits, it appears that the beneficial effects of properly designed control of access to commercial properties will in time become common knowledge.

EDUCATIONAL VALUE

PACIFIC RUBBER COMPANY

OAKLAND 1, CALIFORNIA

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: It is a pleasure to request to be continued on the mailing list of *California Highways and Public Works.*

This magazine has a high educational value, serving to promote good will and a better understanding between the Highway Commission and the public with the commission's problems.

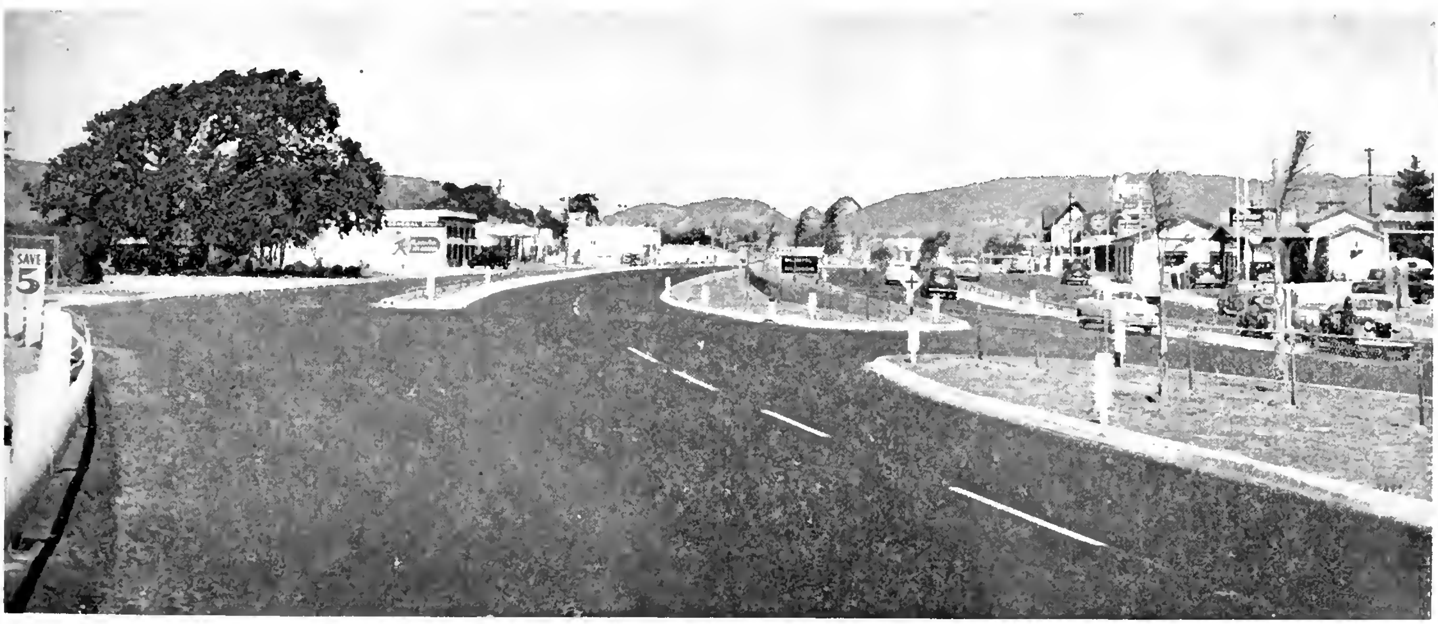
Our San Joaquin River Club boasts over 900 active, dues paying members, and we leave the magazine available to the members until the next issue arrives; then the old one is placed on the magazine table here in the lobby of the rubber company, where it creates considerable interest.

Thanking you for a good periodical, for including us on your mailing list and for this opportunity to express our appreciation.

Yours very truly,

E. F. HILLENDAHL

View of the business section of Buellton showing the manner in which businesses formerly reached directly from the through traffic lanes now are served by frontage roads connected to the highway at cross street intervals



Arnold Highway

Third Link of Industrial Route In Contra Costa County Being Built

By D. M. YOUNG, Resident Engineer

Completion of the third link of the Arnold Industrial Highway, State Route 75, Sign Route 4, in northern Contra Costa County will be accomplished this summer.

Work on the project from the junction of Port Chicago Road to Railroad Avenue at the southern outskirts of Pittsburg was begun by Parish Bros. on March 13, 1950, and is still under construction. This section of road, four and one-half miles in length, will be a four-lane divided limited freeway, consisting of plant-mixed surfacing on cement treated base.

Easy grades and direct alignment were afforded this portion due to the slightly rolling terrain and lack of realty development. The maximum grade is 4 percent, the average being 1¼ percent. The total curvature is 65 degrees and the minimum radius is 2,400 feet.

Overhead Structure

An overhead structure is constructed at the junction at the west end of the job which will provide for the free merging of west bound traffic. At the Bailey Road intersection where cross traffic is light a channelized grade connection will serve until future conditions warrant the construction of a grade separation structure. Both of these connections will be provided with illumination. The connection at the east end of the project will be a temporary grade crossing, including a detour to provide for the routing of traffic during construction of an interchange structure on a future contract.

The geometric section consists of four 12-foot lanes with 8-foot outside shoulders and a curbed division strip varying in width from a minimum of 6 feet in the curbed area to 42 feet in the uncurbed area. The surfacing is four inches of plant mixed material, using paving asphalt, placed on twenty inches of imported base material of which the top eight inches is treated with cement.

The use of cement for treating imported base materials, or selected materials, on road projects has become prevalent in this locality due to insufficient deposits of adequate untreated roadbed materials.

Utilities Relocated

Under the Collier-Burns Act, numerous utilities relocated their facilities at state expense, including a power line owned by the Pacific Gas and Electric Co. Under contract work reinforced concrete encasement was provided for the double sixty-inch pipes of the Mokelumne aqueduct. This aqueduct, owned and operated by the East Bay Municipal Utility District, provides a daily supply of approximately 100

Ribbon development and 25-mile zoning of existing route presents a bottleneck for peak hour traffic

million gallons of water to the East Bay area from the Sierra Nevada mountains.

Due to unseasonal heavy rains, progress on this project, like many others, was temporarily halted during the winter season. It is anticipated that the completion date of this project will be about July, 1951.

A fourth project is programmed for the immediate future, which will extend the four-lane limited freeway to "A" Street at the southern outskirts of Antioch. This unit, when completed, will have extended the Arnold Industrial Highway to include the limits of the Pittsburg-Antioch industrial area, and will afford much needed traffic relief for northern Contra Costa County.

Other Projects Planned

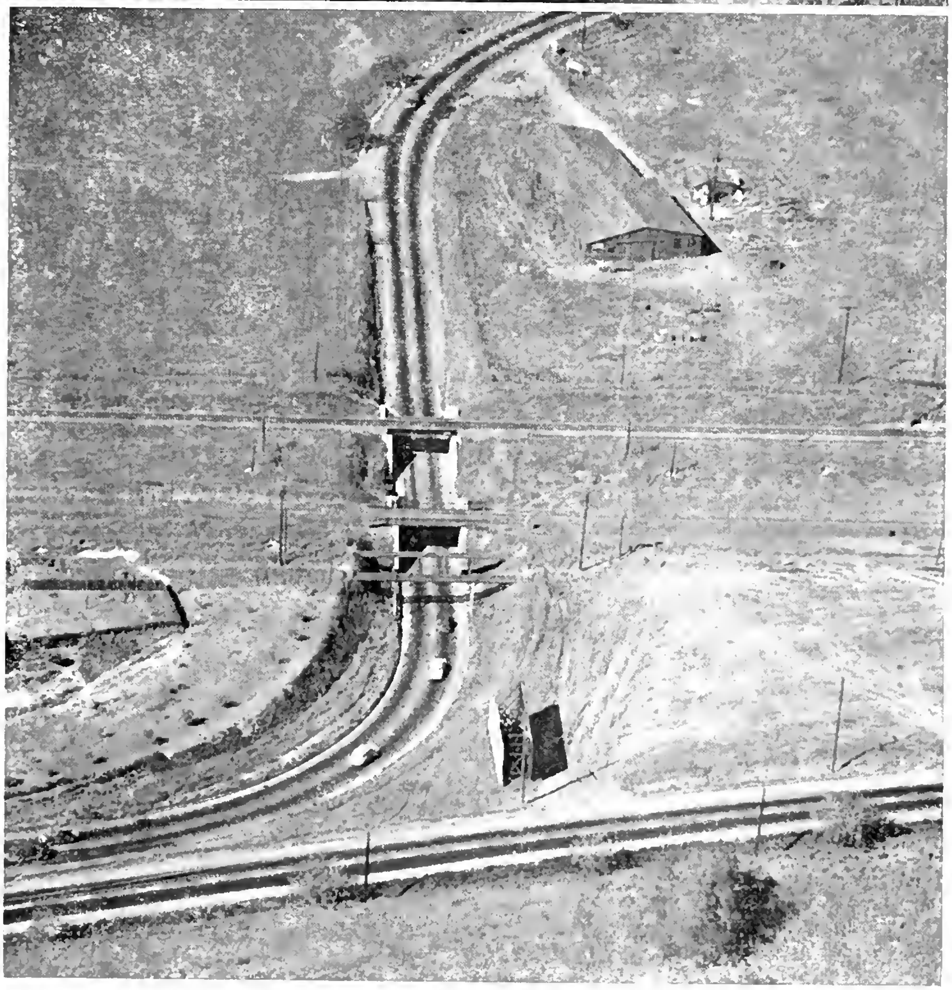
Other projects planned for the future will extend this highway to a junction with Bridgehead Avenue leading to the Antioch Bridge and beyond; across the Contra Costa San Joaquin County line to Stockton.

The present project is financed by state gas tax and Federal Aid funds. The work is under the general supervision of Assistant State Highway Engineer Jno. H. Skeggs, with the author as Resident Engineer on the current project.

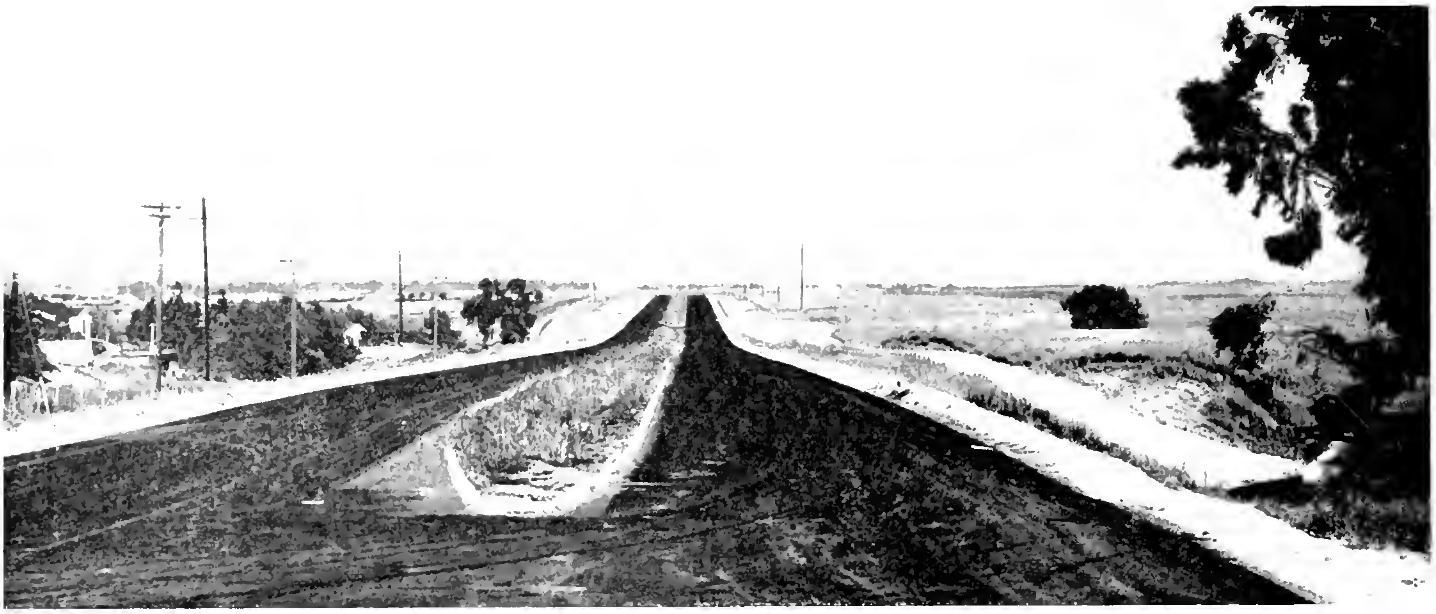
Need for this east-west route was given impetus by the opening in 1925 of the Antioch Bridge across the Sacramento River near Antioch, thereby offering a shorter route from Sacramento and the neighboring delta lands to the San Francisco Bay area. At that time traffic was served by a devious route following along the waterfront of Suisun Bay through Martinez via Franklin Canyon to Pinole and the East Bay district. An alternate road, Sign Route 24, was from Antioch through Concord and Walnut Creek by way of the old Broadway Tunnel.

Roads Were Inadequate

These roads were inadequate in structural design, alignment and width to cope with the traffic which even then foreshadowed its present high level. In addition, no direct route was available to serve the ever-increasing farm produce, transportation and freight from the expanding Pittsburg-Antioch industrial developments. Today this sector includes plants of the Columbia Steel Co., Fibreboard Products, Dow



UPPER—Curving approaches to narrow subway on existing highway are both hazardous and delaying to modern traffic. LOWER—Aerial view of underpass with new highway in immediate foreground.



Completion of surfacing in this area. Direct alignment and easy grades are major features of this project.

Chemical and a generating station of the Pacific Gas and Electric Co., with an attendant increase in commuter traffic. The Army staging area, near Pittsburg, for the San Francisco Port of Embarkation contributes to the congestion, as do refineries of Shell, Associated and Standard Oil Companies.

In 1930 Mr. Ralph R. Arnold, pioneer highway builder and then county surveyor for Contra Costa County, conceived a plan for a direct route from Pinole on Highway 40 to Stockton, intercepting traffic from the Antioch Bridge and passing along the outskirts of the intervening towns. This plan was presented to the various Chambers of Commerce, the Contra Costa Board of Supervisors and the Division of Highways, following which favorable consideration was accorded the plan by all bodies.

On August 27, 1938, ground breaking ceremonies were performed dedicating initial construction of the "Arnold Industrial Highway." This first project, completed in August, 1939, provided a modern two-lane highway from Muir Station to a junction with Highway 24 at the west end of Willow Pass. Muir Station, one mile south of Martinez, was the homesite of John Muir, early California writer and naturalist. This project, constructed by Macco Construction Co., is eight miles in length through rolling hills, consisting of plant-mixed surfacing over soil cement base. The alignment is excellent and affords a considerable saving in time and mileage over the old "Waterfront" Road.

The second project, completed in August, 1947, provided a four-lane divided freeway through Willow Pass to the junction of the Port Chicago road, four miles west of Pittsburg. This section constructed by Harms Bros. of

. . . Continued on page 30

Connection to Port Chicago Road at beginning of project. Grade separation structure provides for the free merging of westbound traffic.

New Approach

Reliable Method of Aggregate Gradation Control Is in Use

By MAURICE E. CORNELIUS, Assistant Highway Engineer

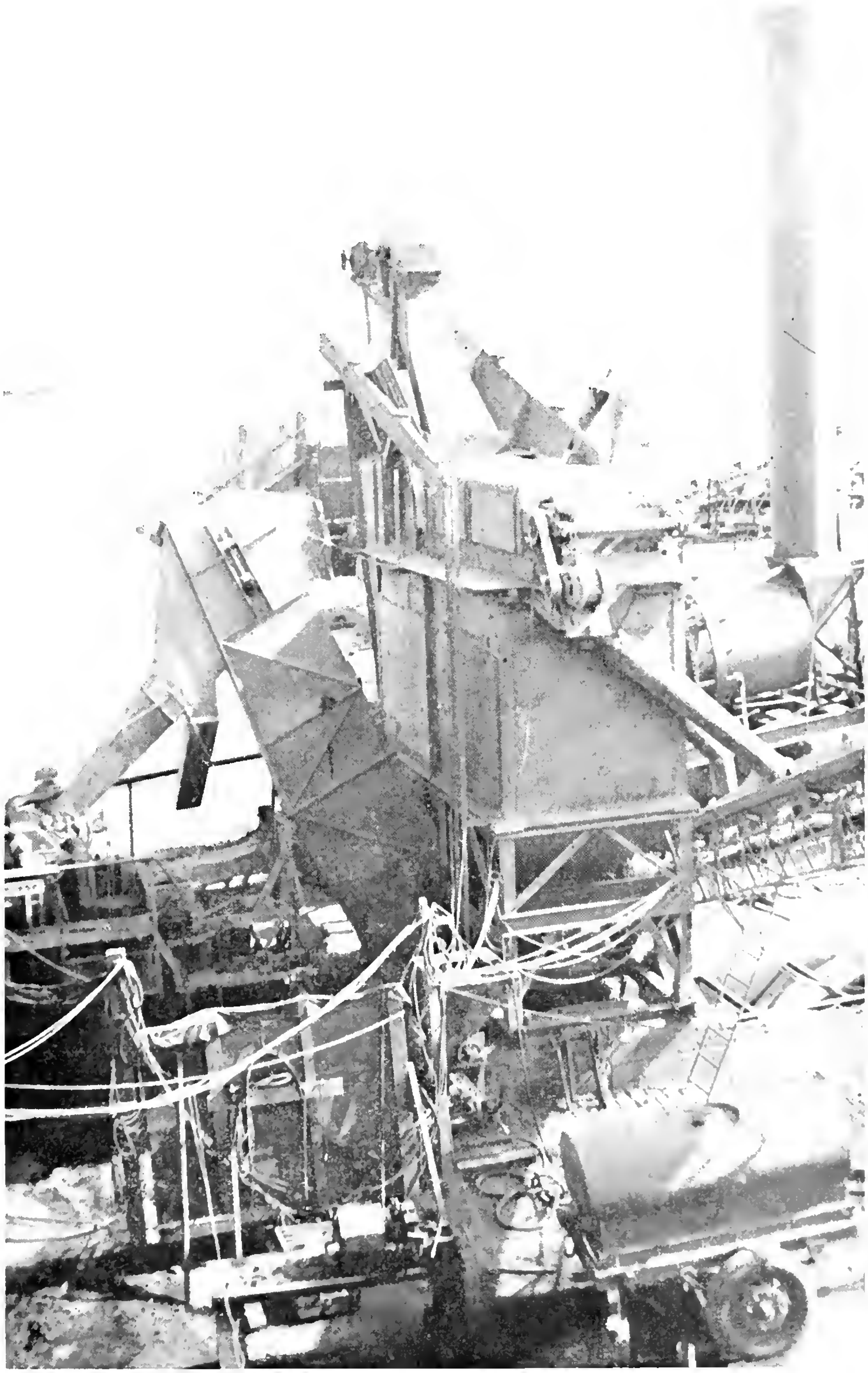
A FEASIBLE and reliable method of aggregate gradation control was installed on a continuous mixing plant for the production of plant-mixed surfacing by the Cox Brothers Construction Company on recent contracts in District XI. Continuous mixers proportion aggregate on a volumetric basis and have always presented problems in production control.

The aims of production control in the mixing of heavy duty asphaltic paving mixtures are (1) to obtain uniform grading of the aggregate, (2) to obtain uniform and proper proportion of bituminous binder to this aggregate, (3) to maintain proper and even temperatures of the mixture and its ingredients, and (4) adequate mixing of aggregate and asphalt. Uniform grading of the aggregate is essential for proper laying and compacting operations and it is also essential in maintaining the correct proportions between the aggregate and the asphalt binder.

Aggregates Proportioned

Grading of the total aggregate is obtained by proportioning aggregates of different size groups; i.e., sand, pea gravel, rock, etc.; the proportions so chosen so as to provide total aggregate within specified grading limits and, further, to obtain a grading within these limits which will produce as little waste material as possible.

To secure a given final grading of aggregate it is necessary to know the gradings of the separate materials being used. In order to acquire these gradings samples of each bin are secured and tested—see footnote at end of article. Continual sampling and testing of the bins is necessary to obtain uniform grading in the final product. Bin grad-



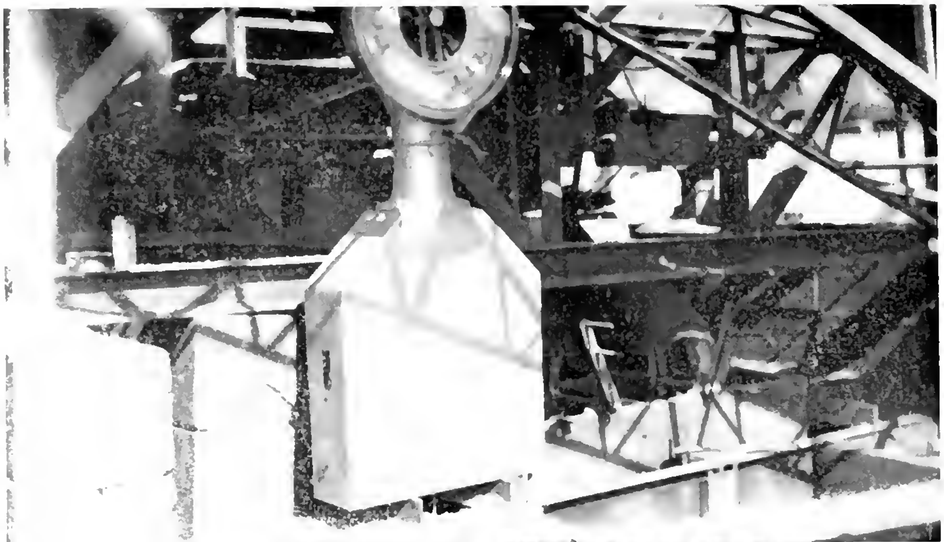
Taken from product hopper tower. On the left is one end of the mixer. The mixer is fed by the closed bucket conveyer in the picture's center. This conveyor is in turn fed by endless belts feeding material from the bins through calibrated gates.

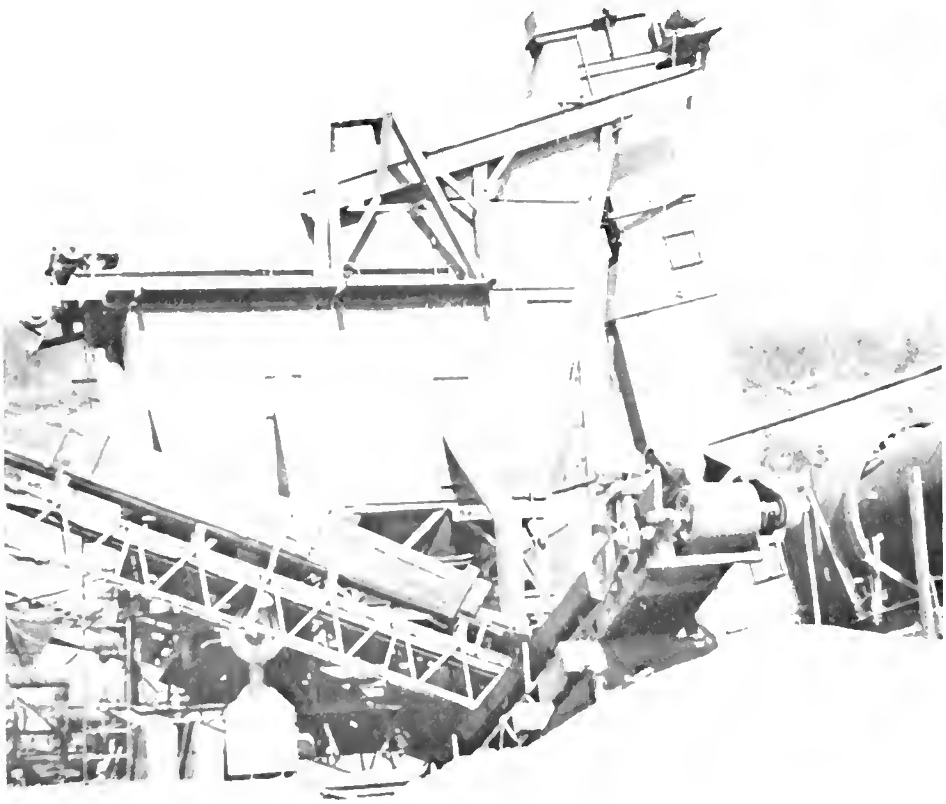
ings will vary with production rates and with depth and location in the stockpile. Testing will also disclose defects in the screening operation, such as plugged screens causing excessive carryover, overloaded screens, plugged overflow chutes, or broken screens. The proportions chosen for the bins will depend upon the gradings obtained by test.

Different Operations

In batch plant mixing one batch at a time is mixed, proportioning being accomplished by weighing out each ingredient of the batch. All ingredients are then dumped into the mixer and mixed. The mixer is then emptied and the process repeated. Gradation control is accomplished by setting the weights desired of each aggregate bin.

In continuous plant operation, mixing is a continual process with unmixed material entering one end of the mixing chamber at the same rate mixed material is leaving the other end. Proportioning is accomplished by allowing the various aggregates to flow from





Taken from the side opposite the mixer. Note dial scale and the conveyor belt leading from under the four-compartment weighing hopper.

ABOVE—Showing arrangement of weighing hopper under the gradation control unit. The control handle visible above and to the right of center is the control for diverting the material from the feed belts to the weighing hopper. It is shown in position to allow the material to go up the bucket conveyor to the mixer. The cleated belt to the left of the dial scale feeds three- and four-bin materials. BELOW—Showing chute arrangement. One chute and one weighing compartment is provided for each bin. The belt in the foreground feeds one- and two-bin materials.

their reservoir hoppers through gates at a constant rate. Gradation control is achieved by setting these gates on openings which will permit a given weight per unit time to pass from each bin into the mixer. Herein lies the crux of the problem. How is the proper gate setting for each bin to be determined and how may the flow through these gates be checked from time to time as the plant is operating?

Calibrotion of Gates

With most mixers of this type the belt or belts which feed the material from the bins through the gates empty directly into the mixing chamber. Hence, the only way to calibrate these gates is to work with one at a time by closing off the others. Calibration is accomplished by setting this gate at various openings, say two, four and six inches, and determining the pounds per feed belt revolution for each setting by running the plant and passing the material through the mixer and thence to weighed trucks. By again weighing the trucks the total weight passed can be determined and the pounds per belt revolution is computed by dividing this figure by the number of revolutions the belt turned during the test. Before making a test the plant must be run for a sufficient length of time to assure the material leaving the plant is identical to that entering through the gate. When three points have been determined for a gate, a graph of output versus gate opening can be made.

This is essentially the method practiced in calibrating the aggregate gates on most continuous mixing plants. It is a costly time-consuming process with other disadvantages. Among these disadvantages, is the difficulty encountered in securing representative samples of the material being drawn from each bin in order to check the screening efficiency. Also, as the grading in each bin may vary from time to time as mentioned above, the weight passing through a given gate may vary for a set opening. Although the total pounds of aggregate per belt revolution can be determined during production the contribution of any one gate is still in doubt.

Gradotion Control Unit

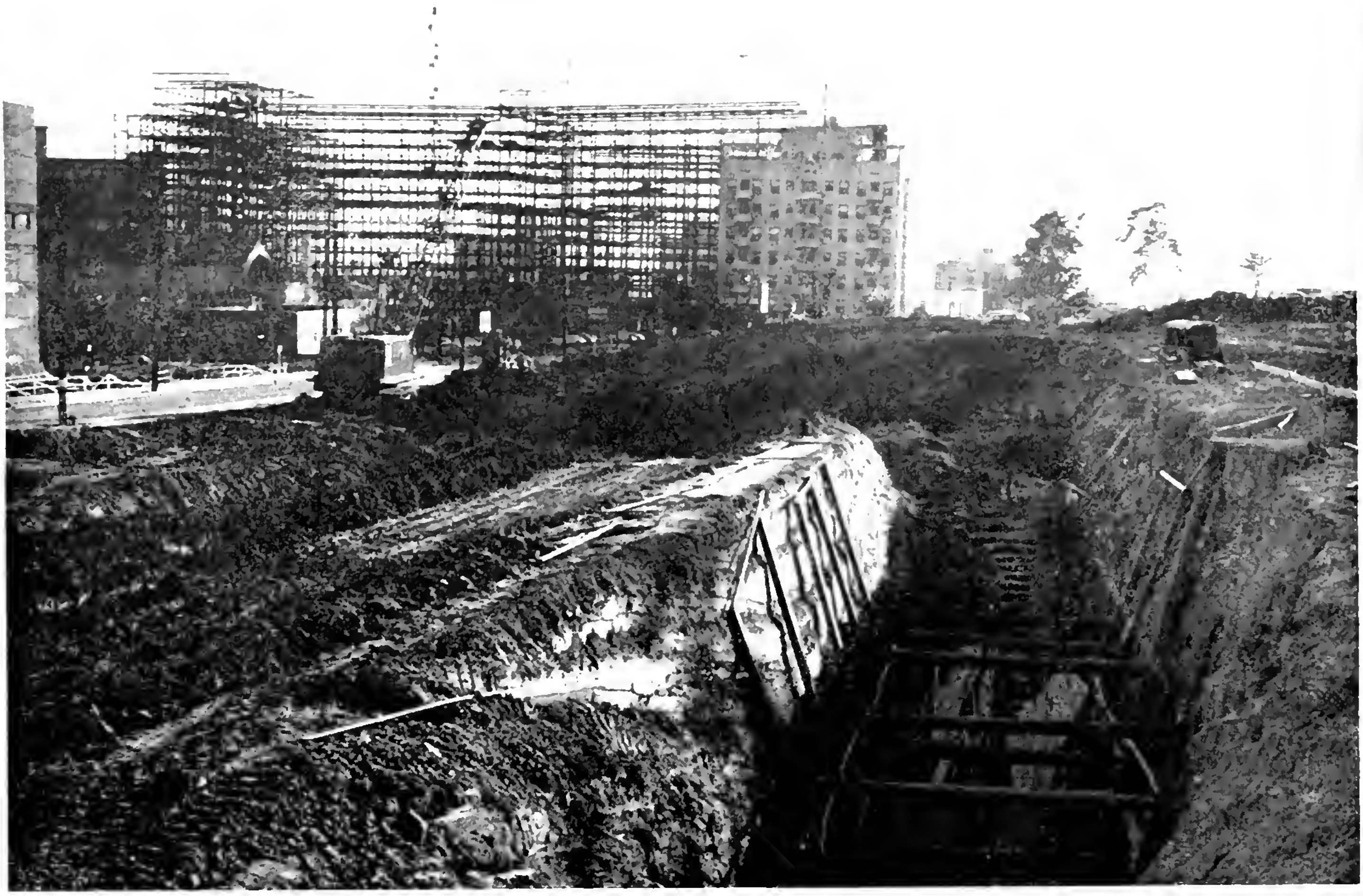
The manufacturers of continous mixing equipment have provided a gradation control unit as the answer to the problem. Essentially this unit provides means of tapping and diverting to individual large sampling buckets the material from the bins just as it leaves the gates. The buckets can then be moved and weighed. A revolution counter reading to hundredths of a revolution is provided; a refinement made necessary by the relatively small capacity of the buckets. This method provides means of calibrating all gates at the same time and provides opportunity to check each gate's output during production. This also supplies samples of each bin material as desired.

ABOVE—Showing the control gate for one of the bins (upper center of picture). LEFT—Sample reduction device mentioned in the text's footnote.

This unit is the big step in securing close control, but it is subject to some criticism. First, it is questionable if one is justified to base production calculations for productions as high as two hundred tons an hour on a short sampling period, normally about three seconds, which includes starting and stopping, even though the revolutions turned can be accurately determined. Second, the buckets must be wrestled from under the unit, the inspector usually being subject to dust and bouncing hot rocks from the reject chutes and belts. This method of control was used in the production of plant-mixed surfacing for the freeway contract between the north city limits of San Diego and Miramar, and provided workable results.

Refinement in Method

A more stringent control, however, was desired for the production of asphaltic concrete for the City of San Diego and the Cox Brothers Construction Company made a further refinement in the method. They installed a four-compartment weighing hopper and scales with 10,000-pound capacity under the gradation control unit and



Looking southerly on Harbor Freeway showing in foreground excavation for east abutment of Sixth Street overcrossing grade separation. To the left is shown the steel framework of the Statler Center Hotel.

hence replaced the buckets with a much greater capacity more conveniently situated. Each compartment was supplied with a means of emptying, so the weights from each bin could be determined, using but one dial scale. The compartment outlets opened upon a conveyor belt which carried the material up and away from the unit for return to the stockpile. Good samples were readily secured by cross-cutting the outfall of this belt as the individual compartments were emptied. These samples will naturally represent a much larger cross section of each bin.

This new adaptation was used for the first time in the production of plant-mixed surfacing for the state frontage roads between Couts Street and Rosecrans Street on Highway 101 in San Diego. The pounds per revolution as determined by pay scale weights showed agreements consistently within one-half of 1 percent of the pounds per revolution as determined by this control method.

The contractor is to be commended upon this development. He has pointed the way to a thoroughly reliable method of aggregate gradation control on continuous mixing plants.

Footnote: Samples of each bin are usually taken large enough to assure that representative cross section of the bin has been secured. These samples are generally too large for convenient testing and must be reduced to a smaller sample which will still possess all the characteristics of the larger specimen. This reduction is generally accomplished through the use of a quartering canvas. This is a time-consuming task which has lead to the development of devices to facilitate the operation. A photograph of one such device is appended. This simple tool is easily made from wood or sheet metal, and it will readily split samples as the material is windrowed across the vanes.

Harbor Freeway

Continued from page 13 . . .

the southerly terminus at Battery Street in the San Pedro district, is 22.8 miles in length. The total estimated cost is \$117,000,000, of which \$18,000,000 has been spent or allocated for right of way acquisition and for construction. No estimate can be made as to the time schedule for completion of the entire project because this is dependent upon various factors, one of which is the availability of funds for freeway construction in the Los Angeles area. Present and anticipated allocations of funds indicate that it will be possible for the most northerly portion of the Harbor Freeway from the Hollywood Freeway to 18th Street near Washington Boulevard to be completed and opened to traffic by the end of 1953 or early in 1954.

In Memoriam

THOMAS EASTMAN

With the death of Thomas Eastman on January 23, 1951, at Fresno, at the age of 61, the Division of Highways lost a loyal and valuable long-time employee, and his many friends and acquaintances were saddened at his passing, following a heart attack suffered December 28, 1950.

He was a native of Kansas but finished his formal education in engineering at California State Polytechnic College, San Luis Obispo, to which city his parents and family had moved. In 1912 he entered the State Highway Department service in District V working in various capacities, including duties up to resident engineer. In 1926 he accepted employment in District VI out of Fresno, from which time his employment in that district was continuous. During a break in service prior to 1926 for several months he worked for a private engineering firm and was engaged in making location surveys for portions of the Santa Maria to Maricopa Road, now State Highway Route 57.

In District VI, Tom will be chiefly remembered for his work in the District Maintenance Department to which he contributed many novel ideas in adopting equipment to the changing highway maintenance needs, many of which received statewide recognition and adoption.

A son, Major Thomas F. Eastman, U. S. Air Force in Japan and Korea, arrived on January 22d on emergency leave. Other surviving relatives include a sister, Miss Corra F. Eastman of San Luis Obispo, and four brothers—Charles of Los Angeles, Philip of Northfork, Gus of Mariposa and Richard of San Luis Obispo.

James A. Stauff Earns Retirement

Highway Foreman James A. Stauff will retire on April 30th at the age of 70. He first went to work for the State Division of Highways in March, 1912, as an axman on a survey party. Later in the same year he was promoted to rodman at a salary of $65 per month. During these long past years he worked on the original surveys of what are now some of our most important state highways. One of these was the Ridge Route, where the survey party set the stakes for the first highway contract over the hills.

Jim later worked in Imperial County on a survey party and resigned from state service in 1916 for other employment. Returning to the State in 1918, he worked as sub-foreman at Bostonia in San Diego County. In 1926, he moved to the Los Flores Maintenance Station, near Santa Monica, and worked there until 1933 as Maintenance Foreman. The next 11 years were spent at Ojai in Ventura County, and the past seven years at the Glendora Maintenance Station in Los Angeles County.

Jim was married in August of 1950 and has since purchased a home in Glendora and a new house trailer. After retirement, he plans to enjoy a leisure life in his new home during the winter months and to travel around the country, living in his trailer, during the summer months.

JAMES A. STAUFF

The best wishes of the entire department go with Jim upon his well-earned retirement, and we hope that he and Mrs. Stauff will enjoy life for many years to come in their new home and their new trailer.

LIKES MAGAZINE

ALAMEDA, CALIFORNIA

California Highways and Public Works
Sacramento, California

GENTLEMEN: I have been receiving your valued publication, *California Highways and Public Works*, for several years and regard it as the most important and interesting of all the publications that I receive. I never delay in reading it from cover to cover. Even do I take trips to see, enjoy and appreciate the highway improvements mentioned therein.

Very truly yours,

ELBRIDGE F. RUSSELL

THANK YOU

ESTHERVILLE, IOWA
March 28, 1951

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California.

DEAR MR. ADAMS: I wish to commend you on your publication which is the most interesting of any technical publication I receive. From limited freeways to shovel specifications, all is ably and interestingly presented.

My copies are filed for reference and used at various times, and I look forward to each new issue with interest.

Sincerely yours,

NEIL K. BROWN

Weed Control

Soil Sterilization to Limit Fire Hazard Is Proving Successful

By HAROLD M. BARNES, Highway Superintendent, District VIII

Soil sterilization by use of a solution consisting of 25 percent sodium chlorate and 75 percent borax has been used in District VIII, San Bernardino and Riverside Counties, for fire hazard weed control since the 1949 season. Thirty tons of the soil sterilization agent have been applied each season under a progressive program, based on the assumption that two successive seasonal treatments would provide sufficient sterilization of the soil so that only spot treatment would be required the third year. The results have permitted an increase in the total mileage treated this season.

Since the treatment has been satisfactory, it is anticipated that the mileage can be increased again next season without increasing the amount of material used per year. The seasonal rainfall has been subnormal during the past three years, however, the treatment appears to be just as effective at the higher elevations, where the precipitation is greater, as at the lower elevations.

Materials Satisfactory

The blended chemical materials have been satisfactory both in regard to application and results. The material is packaged in paper bags, 100 pounds per unit. Spraying should be done early in the year and completed before the growing season is hardly begun. This allows the use of the spraying equipment during the off season when it is not needed for oil spraying or watering of trees. The single application per season has the advantage over petroleum sprays in which retreatment is necessary as the season advances and new growth starts. Spraying at this season eliminates fine grass and weed tinder under brush. The brush will die and the leaves and smaller portions will blow off before fire season, in most instances leaving the brush much less inflammable than when green.

The spraying equipment used consists essentially of a three-axle, 2,000-gallon capacity tank truck with an internal agitator and a one-inch pump.

City Creek highway. Second seasonal application at top of fill slope.

City Creek highway. Showing results of single seasonal applicational at beginning of second season.

North of San Bernardino, State Route 31. Difficult location for hand hoeing or grading. Is easily accessible for spraying.

The agitator and pump are powered by a two cylinder air-cooled engine. The power is transmitted through a unit with a main clutch and separate dog clutches so that the agitator and pump can be operated simultaneously or seperately as desired. The engine is equipped with a tachometer and an adjustable governor. The truck engine is also equipped with a tachometer to allow control of the rate of application. A pressure gauge is provided on the pressure side of the pump. The spray bar is side mounted with an arrangement of swivel joints, pulleys and springs which gives the operator complete control of its position. The bar is mounted behind the cab on the right side, and a platform is provided for the operator between the cab and the auxiliary engine. The bar can be raised, lowered, extended out, pulled in, or tipped by means of ropes running through pulleys. By this mechanism striking obstructions such as signs and posts is avoided and the reach kept parallel to the area to be sprayed, whether it is a cut slope, fill slope, berm or ditch. No harm is done if the bar should strike an obstruction as it is held in position fore and aft with springs which return it to a normal position.

The spray bar itself is a little over four feet long, equipped with eight Vee Jet spray tips, and sprays a six foot width evenly. The gauge registers 35 pounds per square inch pressure while spraying. Any obstruction in the tips or of the intake screen causes the gauge reading to vary. Handrails and a platform are provided on the tank with adjustable safety rails around the platform. The dome on the tank has a small hinged inspection cover in a large hinged cover. The large opening is used in recharging.

Light Truck Used

A light truck is used in the operation to haul a supply of material. This truck has red flags, and a "Watch for Equipment" sign displayed on the left rear of the truck. It follows the tank truck at an interval of three to five hundred feet or more, depending on the alignment or traffic conditions. The material truck is usually kept in a position well to the right of the roadway and is stopped while the slow moving tank truck is working around a curve or at a location where sight distance is limited. The tanker is recharged in the field wherever water is available, using material hauled on the light truck.

Duties of Crew

The crew consists of the tank truck driver, spray bar operator and auxiliary truck driver. Their duties, in addition to spraying, are maintaining the warning signs as mentioned above, flagging traffic where required, recharging the tank, cleaning and flushing the tank after each day's run, and servicing the equipment.

Water is started flowing into the tank and the blended chemicals added with the agitator operating. Foaming occurs when some mineralized water is used. The foaming can be controlled by adding five gallons, or less, of kerosene or gasoline. The strongest practical solution has been found to be 2,600 pounds of blended chemicals in the 2,000-gallon tank. The tank is filled to the top after all the blended chemicals are in and foaming of the material if any has been controlled. The above amount of material will be completely dissolved when properly agitated and no undissolved residue will be left in the tank when the liquid has been exhausted.

In general, the solution is applied at the rate of one-sixth gallon per square yard of surface. This may have to be reduced on heavy soils, particularly, if there is considerable moisture in the soil. This rate conforms with the recommendation of the manufacturer printed on the bags. An average of about two or three 2,000 gallon loads per day is applied, depending, of course, on availability of water, distance to job, and continuity of the areas to be sprayed.

The cost of the blended chemicals this season, including tax and freight, was approximately $0.0732 per pound. The average total cost, including material, labor, equipment rental, operation costs, and supervision per six-foot width of treatment was approximately $75 per mile.

ERRATUM

On page 11 of the January-February issue of this magazine the captions under Fig. 5 and Fig. 6 accompanying the article on sign legibility were transposed. The caption "Lower case, night" belongs under the right-hand center drawing, and the caption "Capitals, night" belongs under the left-hand, center drawing.

Prestressed Bridge

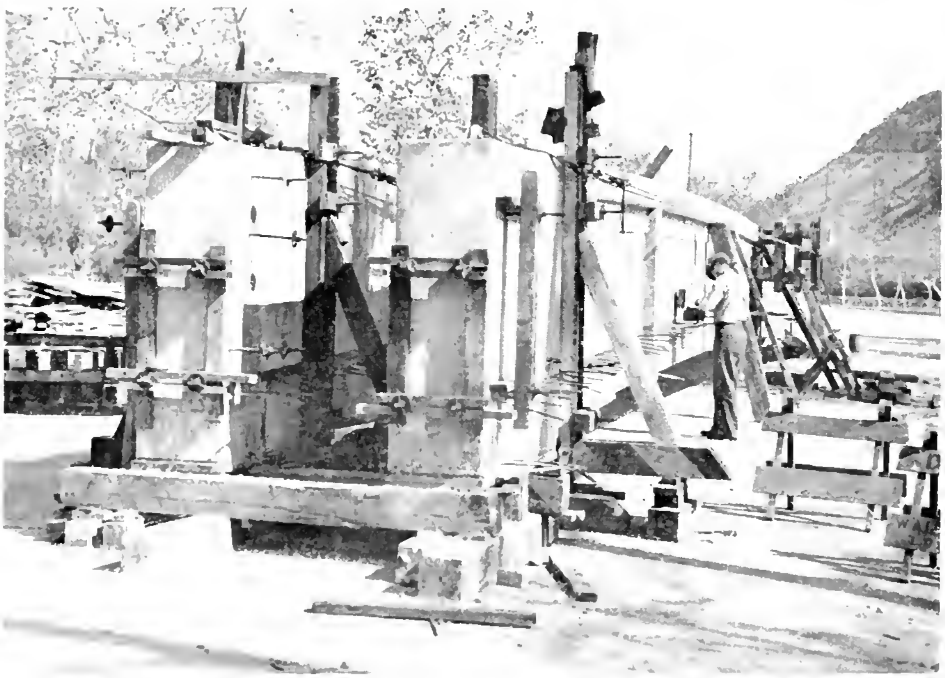
Continued from page 5 . . .

In order that designers may learn whether or not their design assumptions were valid, a testing program is being undertaken by the University of California's Institute of Traffic and Transportation, in cooperation with the Division of Highways. Electrical resistance strain gauges embedded in the concrete will permit the actual stresses in the concrete to be determined at various points under different loadings.

Walter Kaucher, Contractor

The contractor on the bridge was Walter Kaucher of Los Angeles. The Prestressed Concrete Corporation of Kansas City, Missouri, furnished the high-tensile wire and performed all prestressing operations as a subcontract. The bridge was designed by W. J. Jurkovich, Associate Bridge Engineer (now on military leave in Alaska), under the direction of F. W. Panhorst, Assistant State Highway Engineer—Bridges. Jack Sylvester was Resident Engineer on the project for the Bridge Department. The cost of the project, not including engineering, was slightly under $24,000.

Completed girders ready for hoisting. Resident Engineer taking strain gage readings. Anchorages encased in concrete.



Bayshore Highway to Be Freeway

The California Highway Commission has taken preliminary action toward establishment of a portion of the Bayshore Highway as a freeway on new location between Fourth Street and 13th Street in San Jose. The commission requested State Highway Engineer G. T. McCoy to ascertain if the officials of the City of San Jose and the County of Santa Clara desire any further information prior to final action of the commission. This procedure in establishment of freeways has been followed by the Highway Commission since 1948.

The proposed relocation of this portion of the Bayshore Highway is a part of the program to develop it to freeway standards, with structures to carry cross traffic at separate grades and with full control of access. Initial improvement as a four-lane divided freeway is proposed, with provision for ultimate development of six traffic lanes.

After final agreement is reached on the proposed routing, preparation of detail plans will be ordered by the California Highway Commission so that purchase of rights of way and construction may be undertaken when funds become available.

The development of the Bayshore Highway is a problem of primary importance to the San Francisco Bay region and to motorists from other parts of California. The planning has required close cooperation between city, county, and state authorities.

FROM DR. MOYER

UNIVERSITY OF CALIFORNIA
Institute of Transportation and Traffic Engineering
Headquarters: Berkeley 4, California

Mr. Kenneth C. Adams, Editor
California Highways and Public Works
Sacramento, California

Dear Mr. Adams: I am enclosing your post card indicating that I wish to continue to receive the California Highway Magazine.

Permit me to take this occasion to commend you and the Division of Highways on the high quality of your magazine. I consider it to be one of the best references which I have been using continually in my teaching and research work in highway engineering at Iowa State College and at the University of California during the past 15 years. The articles are written in an interesting style, are well illustrated, and are highly informative in regard to all the latest highway developments in California.

I shall look forward with pleasure to receiving future copies of *California Highways.*

Yours very truly,

Ralph A. Moyer
Professor of Civil Engineering and Research Engineer, Institute of Transportation and Traffic Engineering

Westlake Community

Excellent Example of Cooperative Planning

By GEO. S. PINGRY, Assistant Chief Right of Way Agent

WESTLAKE Town and Country Community is an excellent example of modern residential and shopping area planning. This development lies on both sides of State Highway Sign Route 1 immediately south of the San Francisco city limits line and connects Junipero Serra in Daly City with Skyline Boulevard. When construction on this highway was completed in the fall of 1935 the adjacent lands were used for truck gardening.

It is interesting to drive over this highway today and note the transition from truck gardening to a thriving community, due to the efforts of Henry Doelger, a far-sighted builder and subdivider. He has accomplished this transition by building an organization that is doing all things necessary for the creation of this community including the planning and building of 8,000 homes, a $25,000,000 shopping center and a 1,100 unit country club apartment on an area of 1,000 acres. The steps involved in carrying out the project range from the moving of 12,000,000 cubic yards of earth for the developing of pleasing land contours to the

. . . Continued on page 31

This aerial photograph shows the scientific development of the Westlake Town and Country Community just south of the San Francisco city limits

THIS BUSINESS GREATLY BENEFITED BY EXPRESSWAY

By RUDOLF HESS, Headquarters Right of Way Agent

LETTERS like the one received from Mr. George M. Siggins of Ripon, California, who operates a fruit and vegetable stand on U. S. Highway 99, approximately 18 miles south of Stockton, are very gratifying to the Division of Highways because they prove that the many benefits of expressway construction to the traveling public and to roadside businesses are not lost to the small highway businessman.

Mr. Siggins has written as follows:

"I am writing you this letter in regard to the four-lane expressway through Ripon. At the time the highway was being built, I was afraid that it was going to hurt my business, but I have found that I am doing more business than when the highway was only two-lane.

"Last night a car stopped at my business, and the people remarked that they had seen my display while driving south, and decided to stop on the way back. It seems that people driving on a four-lane highway have more of a chance to look around, since there are no cars coming towards them.

"I have been in business on a two-lane highway for 12 years, and on a four-lane highway for more than three years. During the time while on the two-lane highway I noticed that traffic was so heavy that southbound cars could not cross the highway, and northbound cars didn't want to break line.

"It is my feeling that the four-lane highway is much better for business than the two-lane highway."

Since our Land Economics Section has been making use of retail sales tax returns to the State Board of Equalization to determine the effects of access limitation on abutting businesses in various locations throughout the State, we took the liberty of analyzing the sales tax returns reported by Mr. Siggins during the past six years.

In view of the fact that the single ownership of this business and the uniform management practices over the period of many years establish the highway improvement as the predominate business influence, the actual gross volume comparison of the three years since the opening of the expressway to the three years immediately preceding its opening is particularly significant.

Since the expressway was completed in August of 1947, Mr. Siggins has enjoyed a business volume averaging 52.5 percent per year above the average he transacted along the conventional highway.

It is interesting to note that at the time construction of the highway to expressway standards was proposed, Mr. Siggins, like many other businessmen along this section, was very much opposed to the access limitation and the installation of a central division strip separating the opposing lanes of traffic. They expected this installation to reduce their business drastically by limiting patronage to traffic in one direction only.

We thank Mr. Siggins for recognizing the interest that the Division of Highways has in the effects of the limiting of access and the installation of central division strips on roadside businesses. Such information is very useful in answering the many inquiries received from areas where future freeways are contemplated.

View of section of four-lane divided expressway through Ripon in San Joaquin County

Arnold Highway

Continued from page 20 . . .

Sacramento is 2.6 miles in length. The structural section provided four lanes of concrete pavement on cement stabilized base. The previous narrow two-lane road through this area, with its sharp turns and steep grades, acted as a serious bottleneck to the smooth flow of traffic.

HARRY C. DARLING RETIRES AFTER 38 YEARS OF STATE SERVICE

After 38 years of service with the Division of Highways, Harry C. Darling, Senior Highway Engineer, District IV, retired on March 1, 1951. He immediately left on a trip to the great southwest in order to indulge in his favorite hobby of photography in the colorful desert region.

HARRY C. DARLING

Harry Darling embarked on a civil engineering career in 1904. Between the years of 1904 and 1912, he alternately pursued his engineering courses at the University of California and various field engineering assignments with which he furthered his education at the university. He completed his college work in 1912.

Harry's service with the division began on February 15, 1912, when he reported for duty in District III under Walter C. Howe, District Engineer, as instrumentman on surveys north of Sacramento. He became chief of party shortly afterwards.

From 1914 to 1916, he was assigned to construction projects in District III.

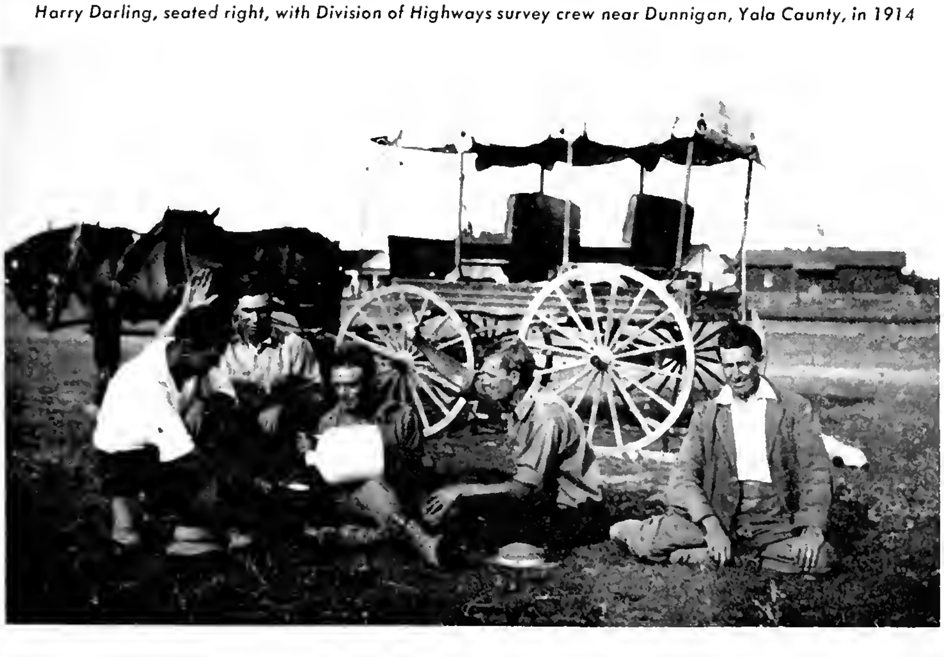
From August, 1917, to March, 1919, he served in World War I as a first lieutenant in the Engineers, U. S. Army, spending a year of that period in France. Upon his return from service, he again reported for duty in District III and was in charge of location surveys. He was also in charge of construction work in the Truckee River area, serving as Resident Engineer.

In 1925 he transferred to District IV and for 25 years has been in charge of highway location in this district. During that period he has successfully met the challenge offered by the many complex problems of modern highway location, and the many outstanding highways of this district are testimony to his skill as a locating engineer.

Harry's many friends within the district will always remember and appreciate his years of unselfish devotion to duty and his sympathetic regard for the welfare of his coworkers.

At a party held in Harry's honor on February 23d in San Francisco, approximately 100 fellow employees gathered to tender their best wishes upon the occasion of his retirement. He was presented with a movie camera projector and other accessories calculated to assist him in pleasantly pursuing his hobby of photography, which he has been fervently anticipating for some time and which a well-earned retirement will now make possible for him to enjoy.

Harry Darling, seated right, with Division of Highways survey crew near Dunnigan, Yolo County, in 1914



Westlake Community

Continued from page 29 . . .

installation of finish hardware in the buildings.

Transportation Problem

In the initial stages of planning a community of this size one of the first problems is that of transportation. The basic fact is that a community cannot live and prosper without a convenient, safe and uninterrupted method of transportation.

In the solution of this problem one fact is paramount: That the prospective occupants of the community, along with other Californians, will use mass transportation only as a last resort. It follows that the answer to the problem is to plan the use of the property adjacent to the highway in such a manner that it will not diminish in any degree the capacity of the highway to handle through traffic. With this thought in mind it becomes clear that allowing direct access to the highway from the abutting properties requires the highway to perform the duties of a city

. . . Continued on page 33

Grant Line Road

Reconstruction of San Joaquin County Route Big Improvement

By CLEMENT A. PLECARPO, Resident Engineer, San Joaquin County Highway Department

On October 20, 1950, Grant Line Road, Federal Aid Secondary Route 908, between U. S. 5 northwest of Tracy and the Holly Sugar Company Spur, was reopened to traffic. The road had been closed to through traffic since June 21, 1950, to allow for complete reconstruction by the county with Federal Aid Secondary and county funds.

The plans, specifications and estimate for the project were prepared and all engineering work was done by San Joaquin County Highway Department engineering forces under the supervision of Julius B. Manthey, County Road Commissioner, and Clyde V. Jones, Deputy County Road Commissioner. The author was Resident Engineer and Elmo Ward was Assistant Resident Engineer.

The work was done under a contract to P. J. Moore & Son of Sacramento at a cost of $104,624.55, exclusive of construction engineering.

Grant Line Road, a county road, begins at the westerly end of the divided section of U. S. 50 northeast of Tracy and runs westerly, by-passing the City of Tracy, to a connection with U. S. 50 northwest of Tracy. The traveled way, prior to reconstruction, was in very poor condition. The pavement was narrow and had an excessive crown and the shoulders were in poor condition. Traffic counts indicated that even with the poor riding conditions more than 4,000 passenger cars and trucks used the road daily. A large portion of this traffic is generated by those drivers desiring to by-pass Tracy.

UPPER—Grant Line Road looking west from Fremont Road after improvement. CENTER—Same section of road before improvement. BOTTOM—New Grant Line Road looking east from Fremont Road.

The road, as reconstructed, consists of a graded roadbed 38 feet wide, an untreated rock base having a minimum thickness of six inches and a width of 24 feet, and a plant-mixed bituminous surface three inches in thickness and 22 feet in width. Untreated rock shoulders with a Class "C-Medium" seal coat were constructed eight feet in width by four inches in thickness over "high-bearing" imported borrow.

Although the entire road is nearly seven miles in length, only the 3.72-mile westerly section was reconstructed inasmuch as the easterly portion was in better condition and because sufficient funds were not available. It is anticipated that when additional funds are available, the balance of the road will be reconstructed.

LOWER—Section of Grant Line Road looking west after improvement. RIGHT—Same section before improvement.

Westlake Community

Continued from page 31 . . .

street, and thereby reduces its potential as a traffic artery. This condition will be created whether the abutting use is residential or commercial but, of course, is greatly accelerated if commercial.

Frontage Road Effective

It was Mr. Doelger's considered opinion after thorough study that the most effective way to control access was by the construction of a frontage road. In this manner the efficiency and life of the highway could be preserved, by the elimination of the possibility of conflicting traffic movements, and the reductions of potential congestion, accidents and driving hazards. In addition, the esthetic appearance of the entire community in approaching from the highway would be immensely improved and guaranteed for all time. Besides the immediate benefits in the protection of the highway, the safety

. . . Continued on page 37

Pacheco Pass

Portions of Historic Road Realigned To Meet Important Industrial Needs

By G. W. LEVIER, Resident Engineer

State Sign Route 152 is a highway which negotiates one of the few passes through the coast range of mountains separating the Santa Clara and San Joaquin Valleys; its destiny is therefore fixed as one of the important highways, especially in regard to industrial service.

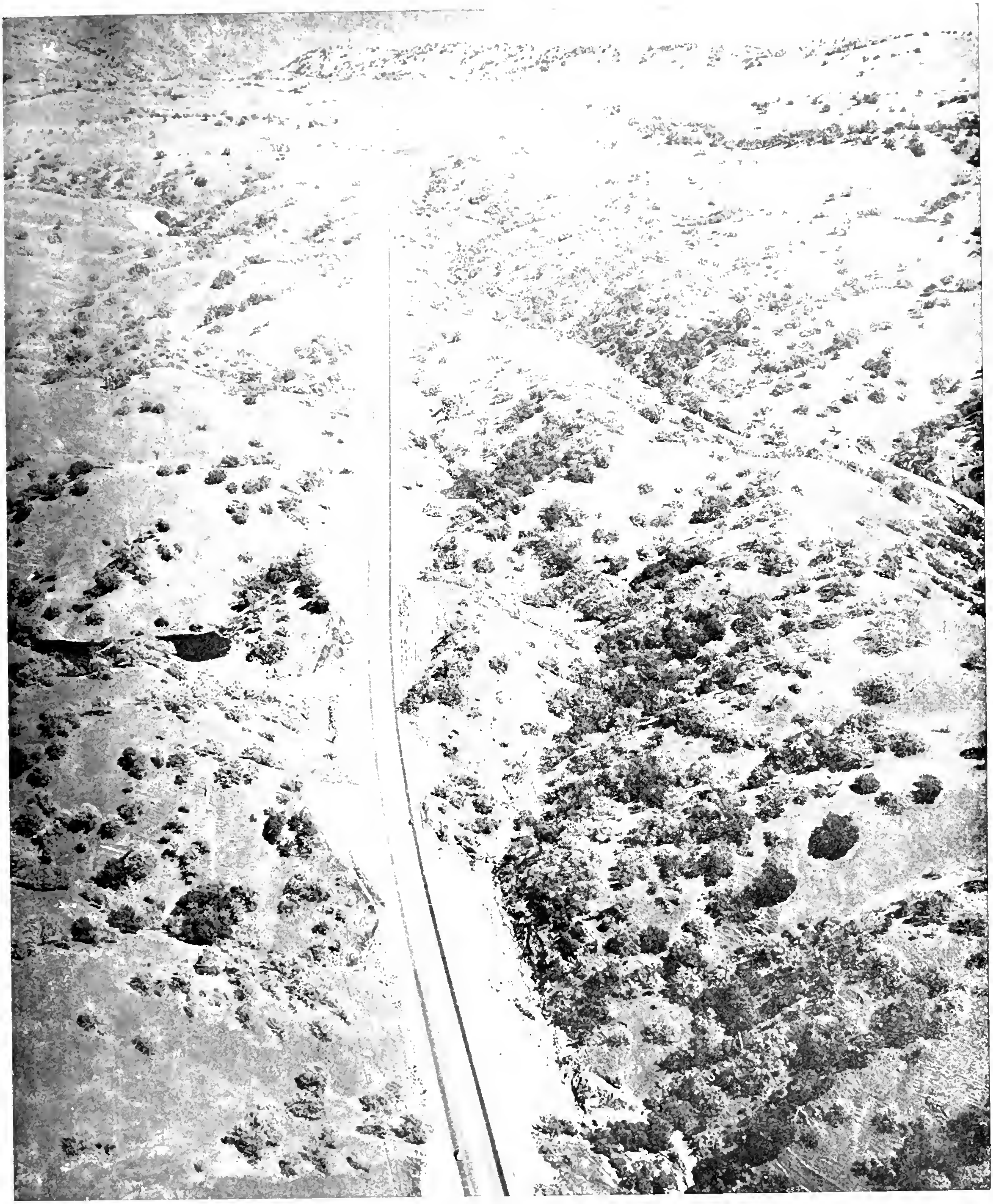
The Indian trail that led through this pass was the one most used by the San Joaquin Indians in going to and from the coast. It was first explored by Lieutenant Gabriel Moraga in 1805 on his way to the San Joaquin Valley in search for new mission sites. It later became known as Pacheco's Pass through the acquisition of extensive land grants throughout the length of the pass by Don Francisco Pacheco. It was first traversed by a road in 1857, when Andrew D. Firebaugh constructed a toll road in order to bring patronage to his ferry. Over this toll road, from 1858 to 1860 ran the Butterfield Overland stages in their long journey from San Francisco to St. Louis, Missouri.

In October, 1858, a Butterfield Overland Stage coach delivered the first United States mail in San Francisco over the overland route from St. Louis. The trip required 23 days, 23 hours and a half. From southern California, Butterfield mail coaches followed a route up the San Joaquin Valley to Fresno City, thence to Firebaugh's Ferry over the Pacheco Pass to Gilroy, thence to San Jose and up the peninsula to San Francisco.

Joaquin Murietta, legendary bandit, had a favorite hideout on the Rancho San Luis Gonzaga on the San Joaquin Valley side of Pacheco pass. He probably used the pass as he was very active in Salinas and this was the main route over the mountains.

Another bandit, Tiburcio Vasquez, used the pass too. For some time he had headquarters in San Benito County. He was active on both sides of the mountains.

Adjoining section of previous construction on Pacheco Pass Highway with the new alignment on right and the old roadway on left



This oerial photogroph shows benching of cuts ond embonkment toe protection on new highwoy

This aerial view of Pacheco Pass Highway shows the contrast between the new construction and old alignment which is marked in ink

Dates Back to 1879

In 1879 the Counties of Santa Clara and Merced purchased the "Old Grade," Firebaugh's toll road, constructed a new road and declared it a public highway. This route was made a part of the State Highway System along with the Bond Issue Act of 1915.

In 1923 the State constructed the third road through this pass, known as the "Yosemite-to-the-Sea" highway.

In May, 1949, that portion of this route from the Merced County line to one mile east of Bell Station was declared a freeway by action of the California Highway Commission. With the letting of Contract 1-4TC94F in October, 1949, to the contracting firm of Eaton and Smith of San Francisco, a section of new highway of modern freeway design was brought to this historic route.

This contract provides for the improvement of a portion of this road between Cape Horn and the Merced County line, a distance of 3.26 miles on a new alignment departing a maximum of 1,800 feet from the old road. A combination of narrow roadbed, numerous sharp curves, and gradients as steep as 7 percent had rendered the old section obsolete. Slow moving vehicles such as trucks ascending and descending the steep grades, where passing sight distance was not available, caused considerable congestion and created potential accident hazards. The military value of the road was demonstrated by the large volume of military traffic using this facility during the last war.

New Road Modern Design

The new road is of modern design, consisting of a four-lane divided section paved with three inches of plant-mixed surfacing on six inches of cement-treated base over 15 inches of selected material. The total width is 74 feet between shoulder points, comprised of a six-foot division strip with raised bars, and 26 feet of pavement and an eight-foot paved shoulder on each side. Plant-mixed dikes were constructed on the fill sections and plant-mixed gutters through the cuts to control surface drainage.

The topography in this vicinity is generally mountainous, some of the cuts and fills being over 80 feet in height. There is a difference of 328 feet in elevations within the limits of the project, 750,000 cubic yards of excavation being required to perform the roadway grading which was of a rocky nature. The higher cuts were benched at varying heights of 39 feet to 48 feet above profile grade as protection against future slides. By judicious use of blasting methods, no overbreak occurred and all rock cut slopes are uniform.

A widened area was provided left and right of the road at the summit near the easterly end of the project where trucks can pull off the road for mechanical inspection prior to descending the sustained grades on either side of the mountain range.

It required 30,000 cubic yards of channel excavation to redirect the run-off of the main watershed, a branch of the South Fork of Pacheco Creek, and its tributaries. This is a section of heavy run-offs due to the steep natural slopes and sparse vegetation.

The structure work on the contract consisted of extending reinforced concrete arches to pass the main tributary of the South Fork of Pacheco Creek as it meanders across the road at the beginning of the project. There were also two 10-foot x 10-foot cattle passes constructed under this work item to serve the cattle ranges on both sides of the road.

The surfacing and base materials were produced by subcontractors Clements and Company of Hayward from the gravel in Pacheco Creek, about five miles west of the job site. The total quantities required for the work were 38,000 tons of imported base material, which was cement-treated by road-mixing methods, and 23,000 tons of aggregate for plant-mixed surfacing which was mixed at this site in the subcontractor's 3,000-pound asphalt plant.

The contract, in the amount of $888,192.90, was awarded on October 28, 1949. Work started on the project on November 3, 1949, and proceeded normally with an estimated completion date of about December 31, 1950.

The work is financed by gas tax and Federal Aid funds, and is being constructed under the general supervision of Assistant State Highway Engineer Jno. H. Skeggs, with the author as Resident Engineer.

Westlake Community

Continued from page 33 . . .

and convenience to the motorist, and the esthetic appearance, the contributing effect towards the retention of real estate values over an extended period of time more than offsets any possible additional expense in the original installation.

Shopping Needs Served

The accompanying photograph depicts a portion of the residential area now under construction and clearly shows the first completed section of 2,835 feet of frontage road on the north side of the highway and the 4,185 feet on the south side. The development when completed will provide frontage road over the entire length between Junipero Serra and Skyline Boulevard, a distance of one and one-half miles, with the allowance of only four openings to the through lanes of traffic.

To provide for the shopping needs of the area an intergraded retail center is being built at a location sufficiently removed from the highway to allow adequate customer parking and controlled shopper circulation. This discarding of the Main Street pattern of retail business development in itself contributes greatly to the protection of the highway.

Mr. Doelger has exhibited a clear conception of the economics involved in highway planning and construction and has been extremely cooperative with the Division of Highways in its effort, by the control of access, to protect the investment of the people of California in their highway system.

BABY SHOES

Junior's baby shoes or other objects may be a precious memento, but they are out of place dangling from the rear-view mirror of your car. Present-day driving is hazardous enough without intentionally adding to the danger, warns the California State Automobile Association.

HALF DOME

Thousands of amateur and professional photographers have taken pictures of the famous Half Dome in Yosemite Valley. *California Highways and Public Works* considers the one herewith reproduced, which was taken by Paul Dunckhorst, Assistant Bridge Engineer, Division of Highways, one of the most striking.

"The clouds had been closing in on the valley during the late afternoon, and while driving along we noticed that the lights and shadows playing on Half Dome suggested interesting possibilities," Dunckhorst said.

"I set up my camera near the bank of the Merced River and waited a half hour. The photo was made early in June at 5.30 p.m. with 4 x 5 Speed Graphic; 135 mm. Optar lens with G filter on Isopan."

Awarded Silver Star

Chief Warrant Officer Russell J. Waggoner, automobile mechanic on leave from District IV of the Division of Highways, has been awarded the Silver Star for service at the front in Korea.

Waggoner received the Silver Star, fourth highest U. S. service medal, for "conspicuous gallantry in action against an armed enemy * * *" The citation states that his actions contributed materially to the successful breakthrough of United Nations troops in the Chosin Reservoir area. He is serving with the First Marine Division. Waggoner's wife, Ela, and their two children live at 198 Boye Road, Concord.

SLOW IN SCHOOL ZONES

Always obey the signs that warn of a school zone. Many school crossings are patrolled by police, as well as School Safety Patrols, but it is impossible to have an officer at every intersection. Be especially careful at school crossings and cooperate with the School Safety Patrols.

Bonner Grade

Historic Road in Modoc County Rapidly Being Modernized

By H. H. HOOVER, Associate Highway Engineer

Culminating over a century of road building, a modern high-speed highway over the Warner Range is at last a reality. This range was a principal barrier to the northern route of the Emigrant Trail which followed across northern Nevada, over the Warners, and down to the upper Sacramento Valley at Vina, near Red Bluff. This route was used extensively in 1849 by the gold seekers.

The Warner Range has the distinction of being a secondary continental divide as the west slope drains into the Pacific Ocean while the run-off from the east slope flows into undrained desert basins and evaporates.

Surprise Valley in eastern Modoc County, on the east slope of the Warners was settled in the 1860's and comprises some of the richest farming land in the State, with stockraising as the principal occupation. Hunting is excellent, and every fall this area is a mecca for deer hunters from all over the State.

This photograph of early construction on the Alturas and Cedarville Road through a lava rock cut was taken in 1906

Indian Uprising

The last Indian uprising and massacre took place near Surprise Valley in 1911. Four cattlemen were killed by a small band of renegade Indians under the leadership of Shoshone Mike. The ranchers were shot when they caught the Indian raiding party rustling cattle. Upon discovery of the murders a posse was formed and after a 270-mile chase across northern Nevada the outlaws were caught and killed in a fierce battle. Only one girl and three papooses of the raiding party survived.

Modoc County was once part of the State of Deseret, then a part of Utah, later a part of Nevada, and in California as a part of Siskiyou County before attaining its present status. Deseret was never recognized by the United States.

Cedarville, which is now the largest town in the valley, was settled while a part of Siskiyou County. The road over the Warners was 15 miles north of the present route and was little more than a trail. The citizens of Cedarville petitioned the Board of Supervisors of Siskiyou County to have the road relocated and improved. Because of remoteness of this section and general lack of funds the supervisors refused this request. Then the enterprising people of this small community took matters into their hands and in 1869 built a road over Cedar Pass. Maintenance was carried on by these progressive pioneers for several years until the supervisors at Yreka accepted the road. John Bonner was one of the leaders in the construction of this road and in his honor the route was made an official state historical monument under the name of Bonner Grade.

State Gives Aid

Bonner Grade was used for many years with very little improvement and would become impassable during the winter months. During bad weather a block and tackle was necessary to pull the heavy freight wagons over these grades. In 1905 the State of California in a cooperative effort appropriated $7,000 for reconstruction of portions of this road. The County of Modoc appropriated $3,000 to further the work.

The greater part of this money was spent near the summit. On the west side an 18 percent grade and several

This picture graphically illustrates the rugged terrain in which bulldozers had to work on new alignment

sharp curves were eliminated. When finished, these areas had an 8 percent maximum grade and few curves under 50-foot radius. The work was accomplished by use of horse-drawn plows and a road grader.

Labor Trouble

"Portal to portal" pay trouble was experienced even then as described in the following paragraph from the final report by H. S. Smith, Superintendent:

"Later is was found necessary to dismiss several of the men, as they thought they were being worked too hard, having the idea that as this was public work they ought to have a sort of picnic, and because they were compelled to put in eight hours per day on the work (which did not include their going and coming to and from the camp), some made it quite unpleasant for the entire crew, consequently the change referred to was made."

Further construction was done in 1921, 1924, and 1936, with frequent surfacing done as needed.

Economically, this road had much to offer to Northern California. In the absence of a modern route to the west, Surprise Valley and northwest Nevada, residents would haul their products south to Gerlach and Reno, Nevada, over a graveled road. This graveled road is being improved yearly by the State of Nevada and will undoubtedly draw trade from this area. Bonner Grade was also one of the weakest links in the "Winnemucca to the Sea" Highway. This highway west from Winnemucca to Eureka would be invaluable in the case of a national emergency as many miles could be saved between Northern California and the East as well as providing a low level pass through a relatively light snow area.

Road Being Modernized

Modernization and resurfacing of California's portion of this vital highway is progressing rapidly and in the event Nevada improves its portion an enormous increase in through traffic can be expected.

The status of Bonner Grade in 1946 was poor. There were 60-foot radius curves, 7 percent grades and many icy and frosty areas. During the winter, snowstorms would close the road for short periods. High winds and drifting snow made snow removal a very difficult task, and as there wasn't any hospital in Surprise Valley, it was imperative that the road to Alturas be kept open.

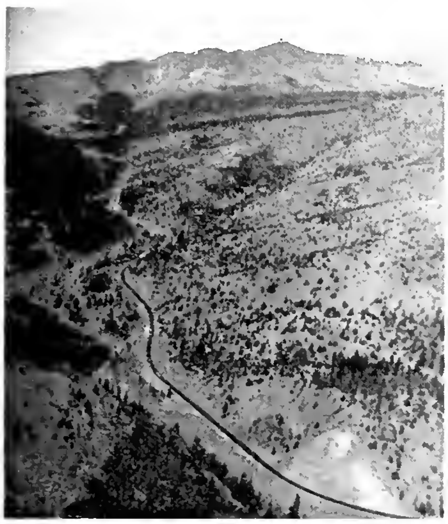
In 1947 and 1948 surveys were made over Bonner Grade. The new road was 5,500 feet shorter and contained 110 less curves than the old route. A sustained grade of 6 percent was maintained on the new project where as the old road had short stretches of 7 and 8 percent grades.

Work Completed Last January

In the spring of 1949 a contract was let for the grading to R. B. Guerin and Co. It was planned to finish this contract in 1949 and then do the surfacing

Heavy grading on Bonner Grade near Division of Highways maintenance station

Near the summit of Bonner Grade after grading operations. This is the same section as shown in the photo on page 39



Aerial view of the completed Bonner Grade project

in 1950. However, the heavy grading and rocky cuts proved to be too difficult to complete in the short working season and the work was suspended in December, 1949, and resumed in March, 1950.

The surfacing contract was let in the spring of 1950 to Rand Construction Co. The work consisted of a six-inch cement treated base and three inches of plant-mixed surfacing.

The two contracts were pursued concurrently during 1950 and the work was finally accepted January 19, 1951. The approximate final costs of the contracts was $640,000 for the grading, and $305,000 for the surfacing.

A small curb and gutter contract was let by the State in Cedarville during the summer of 1950. This work expedited the drainage and facilitated parking along the last 2,200 feet of the project. The contract was performed by Rand Construction Co. in conjunction with its paving in that area.

Thus, a road was built, which, although at present lacking in traffic count, will prove invaluable in the future and is now indispensable to this isolated section which is truly one of the "Last Frontiers" of the Old West.

The author was resident engineer on the project, under the direction of H. C. Amesbury, District Construction Engineer, and J. W. Trask, District Engineer.

CARBURETOR OVERHAUL

When overhauling the automobile engine, it is advisable to include a carburetor overhaul. Carburetor parts become worn and the jets sometimes become clogged with foreign substances. Since modern carburetors are not adjustable, they must be overhauled by competent mechanics occasionally to insure good gas mileage and proper car performance.

ONE LETTER OF MANY

Department of Commerce
Civil Aeronautics
Administration

District Airport Engineer
206 Appraisers Building
630 Sansome Street
San Francisco, California

Mr. Kenneth C. Adams, Editor
California Highways and Public
Works, Sacramento, California

DEAR MR. ADAMS: As we have been interested in the possibility of reworking and salvaging bituminous pavements, we have noticed among other interesting articles in your November-December, 1950 edition of California Highways and Public Works, the article entitled "An Experiment, Illustrated," by Mr. Earl Whithycombe, Assistant State Highway Engineer.

The California Highway and Public Works Department is to be congratulated for its foresightedness in seeking a method by which old asphalt pavements may be salvaged, as it offers unlimited possibilities and savings to the taxpayer and public works departments over the United States.

Inasmuch as the method offers the same possibilities to airports, we would like to obtain five more copies of the issue so that we may keep our region and other districts abreast of the process.

Very truly yours,

C. G. HAND
District Airport Engineer

FROM MICHIGAN

ANN ARBOR, MICHIGAN

California Highways and Public Works
Sacramento, California

GENTLEMEN: I have read several issues of your magazine with great interest and enjoyment. The fine articles describing California solutions to highway and traffic problems are especially significant. However, I find myself enjoying also parts which would seem—on the surface—to be of slight concern to a nonresident of your State. It is a very inspiring publication.

Very truly yours,

ALGER W. LUCKHAM, JR.

An Order

Public Works Director Defines Incompatible Employment

Statement and determination of the Director of Public Works respecting employments, activities, or enterprises found to be inconsistent, incompatible, or in conflict with the duties of officers and employees of the Department of Public Works, pursuant to Section 19251 of the Government Code, Chapter 474, Statutes of 1949.

TO ALL Officers and Employees of the Department of Public Works:

For the protection of the integrity of the California state service, the law includes standards of conduct with which state officers and employees are expected to comply.

Section 19250 of the Government Code requires that:

"Every state employee shall fulfill to the best of his ability the duties of the office or position conferred upon him and shall prove himself in his behavior inside and outside the service worthy of the esteem which his office or position requires. In his official activities the state employee shall pursue the common good, and, not only be impartial, but so act as neither to endanger his impartiality nor to give occasion for distrust of his impartiality."

Section 19251 of the Government Code requires that:

"A state officer or employee shall not engage in any employment, activity, or enterprise which has been determined to be inconsistent, incompatible, or in conflict with his duties as a state officer or employee or with the duties, functions or responsibilities of his appointing power or the agency by which he is employed.

"Each appointing power shall determine and prescribe, subject to approval of the board, those activities which, for employees under his jurisdiction, will be considered inconsistent, incompatible or in conflict with their duties as state officers or employees. In making this determination the appointing power shall give consideration to employment, activity or enterprise which: (a) involves the use for private gain or advantage of state time, facilities, equipment and supplies; or the badge, uniform, prestige or influence of one's state office or employment or, (b) involves receipt or acceptance by the officer or employee of any money or other consideration from anyone other than the State for the performance of an act which the officer or employee, if not performing such act, would be required or expected to render in the regular course or hours of his state employment or as a part of his duties as a state officer or employee or, (c) involves the performance of an act in other than his capacity as a state officer or employee which act may later be subject directly or indirectly to the control, inspection, review, audit or enforcement by such officer or employee or the agency by which he is employed.

"Each state officer and employee shall during his hours of duty as a state officer or employee and subject to such other laws, rules or regulations as pertain thereto, devote his full time, attention and efforts to his state office or employment."

In accordance with the requirements of Section 19251 of the Government Code of the State of California, the Director of Public Works has determined and prescribed, and with the approval of the State Personnel Board does hereby determine and prescribe, that the following employments, activities, or enterprises, for officers and employees under the jurisdiction of the Department of Public Works and the particular divisions thereof hereinafter listed, are inconsistent, incompatible, or in conflict with their duties as such officers or employees of the State of California:

A. General (Applicable to officers and employees of the director's office and of all divisions of the department).

(1) Providing confidential information to persons * to whom issuance of such information has not been authorized by the director or the chief of the division in which the individual is employed;

(2) Providing or using, unless authorized by the director or such division chief, the names of persons from office records for a mailing list;

(3) Directly or indirectly furnishing estimating services, or any other services or information not available to all prospective bidders, to any person bidding on, or who may reasonably be expected to bid on, a contract with the Department of Public Works or any division thereof;

(4) Engaging in any outside employment on a regular basis which will prevent prompt response to a call to report to duty in an emergency. Exemptions from this rule may be granted in special cases where the employee's regularly assigned duties do not call for off-hour work;

(5) Engaging in any outside employment, the working hours of which prevent the employee from securing adequate rest, and thereby result in lowered efficiency for state work;

(6) Directly or indirectly entering into, or engaging in, any partnership, profit sharing, employment or other business arrangement with any person who has, or thereafter attempts to obtain, a contract or contracts with, or who sells, or may reasonably be expected to sell, equipment or supplies, or services, to the department or any division thereof. Exemptions from this rule may be granted in special cases, where the nature of the particular employee's state work is such that he cannot possibly influence the amount of business done by such person with the department;

(7) Directly or indirectly engaging in the sale of any article or service for profit where the use of state time, facilities, equipment or supplies is in any way involved;

(8) Soliciting or accepting personal loans of money or property from any person, other than a bank or other financial institution, who does business with or performs services for the department or any division thereof, whether under contract or otherwise;

B. Division of Highways

(1) Directly or indirectly to rent or loan privately-owned tools or equipment to a contractor. Exemptions from this rule may be granted by the employee's department head, or by a district engineer, in special cases where the nature of the particular employee's duties are such that he cannot control quantities of work done, or judge the qualities of workmanship, of any contractor.

* Wherever used in this statement, the terms "person" or "persons" includes individuals, firms, partnerships, corporations, associations and all other forms of organization for business or other purposes, and their agent or agents.

C. Division of Architecture

(1) Directly or indirectly entering into any agreement, partnership, profit sharing or employment arrangement, including consulting services, with an architect or engineer to engage in the design of any school building, the construction of which is subject to supervision by the division under the requirements of Sections 18191, et seq., of the Education Code.

D. Division of Contracts and Rights of Way

(1) Directly or indirectly entering into any arrangement with any person which may in any way involve a conflict of interest with the duties and obligations of an attorney representing the State of California.

The limitations, activities, employments or enterprises herein set out do not attempt to specify every possible limitation on activities of officers or employees that might be determined and prescribed under the authority of Section 19251 of the Government Code. If later experience shows a need for additions to, deletions from, or clarification of the limitations stated above, the Director of Public Works will request the approval of the State Personnel Board in making such changes as he may determine necessary. Upon such approval, the above listing will be amended. Nothing in this statement or listing shall be construed by any officer or employee as the sole provisions of law and administrative rules which must be observed by each state officer and employee of this agency.

It is not the desire of the Department of Public Works or any of its divisions to inquire into the private affairs of its employees. We do ask the cooperation of all employees in avoiding any activity that may reasonably be expected to cause embarrassment to the department or the State of California. An employee who is engaging in, or plans to engage in, any employment, activity, or enterprise which conceivably might be inconsistent or incompatible or interfere in any way with his duties as a state employee is asked to consult with his supervisor.

Each and every officer and employee of the Department of Public Works is hereby notified of their right to object to any provision of the foregoing statement and determination by filing a notice thereof with the Director of Public Works, and of their right to file an appeal with the State Personnel Board relative to any action of the director taken with respect to any objection so filed, or with respect to the foregoing statement and determination as a whole.

The determination of the Director of Public Works respecting incompatible employment of employees of the Department of Public Works, dated December 29, 1949, and approved by the State Personnel Board by John F. Fisher, Executive Officer, on January 23, 1950, is hereby rescinded.

Dated at Sacramento this twenty-fourth day of January, 1951.

C. H. PURCELL
Director of Public Works

Tom Bedford Enjoying Retirement in Hemet

THOMAS A. BEDFORD, one of the original seven District Engineers employed by the California Highway Commission in 1911, retired from state service on July 15, 1939. Since his retirement, nearly 12 years ago, "T. A." has spent considerable time galavanting between Mexico, Texas and California. He spent some time on his ranch in Merced County, but has spent the greater portion of the last three years in Hemet.

Approaching his eighty-second birthday, Tom is still the wiry, active man he always has been, retaining a keen interest in highway and engineering matters.

Many of Tom Bedford's host of friends may have lost contact with him during recent years of hectic construction programs and Tom would appreciate hearing from state highway employees who worked with him during his 28 years of service. His address:

Thomas A. Bedford
Hemet, California

In Memoriam

WILLIAM H. SPIRZ

THE EMPLOYEES of the San Francisco-Oakland Bay Bridge and of other units of the Division of Highways deeply mourn the sudden death of William H. Spirz of the Bay Bridge engineering staff on February 16, 1951.

Mr. Spirz was born in San Francisco on May 21, 1902. He received his formal education in the schools of that city and in the University of California, from which he was graduated in 1931 with the degree of Bachelor of Science in Civil Engineering.

During his college years, Mr. Spirz spent his vacations on various engineering jobs. Immediately after graduation, he was employed by the National Park Service, and in 1933 he went to work for the San Francisco-Oakland Bay Bridge on which construction had just started. He spent about five years on engineering office and field work on the Bay Bridge and was transferred to the Bridge Department of the Division of Highways in August, 1938.

With the accelerated war preparedness program, Mr. Spirz was called into active service in the Army in April, 1941, as a First Lieutenant. He received his discharge from the Army in 1945 and immediately returned to the Bay Bridge staff, where he continued his work on the various engineering problems of bridge operation and maintenance until his untimely death in February.

He was an associate member of the American Society of Civil Engineers.

Mr. Spirz is survived by his widow and three brothers, to whom his many friends in the state service extend sincere sympathy.

California Highways

Their Importance in the National Defense Effort

On March 1, 1951, Governor Earl Warren sent to Charles E. Wilson, Director, Office of Defense Mobilization, Washington, D. C., a letter urging that special consideration be given to California in making provision for the allocation of necessary steel and other materials for highway construction in order that the State may make its full contribution to the national defense program. Governor Warren wrote:

THE SERIOUS international situation facing the United States today, imposes a tremendous responsibility on all public officials and private citizens. Every endeavor must be directed toward increasing the production of materials and providing the manpower necessary to expand all phases of the national defense as rapidly as possible.

Attainment of this prime objective is absolutely necessary to the very existence of this Nation.

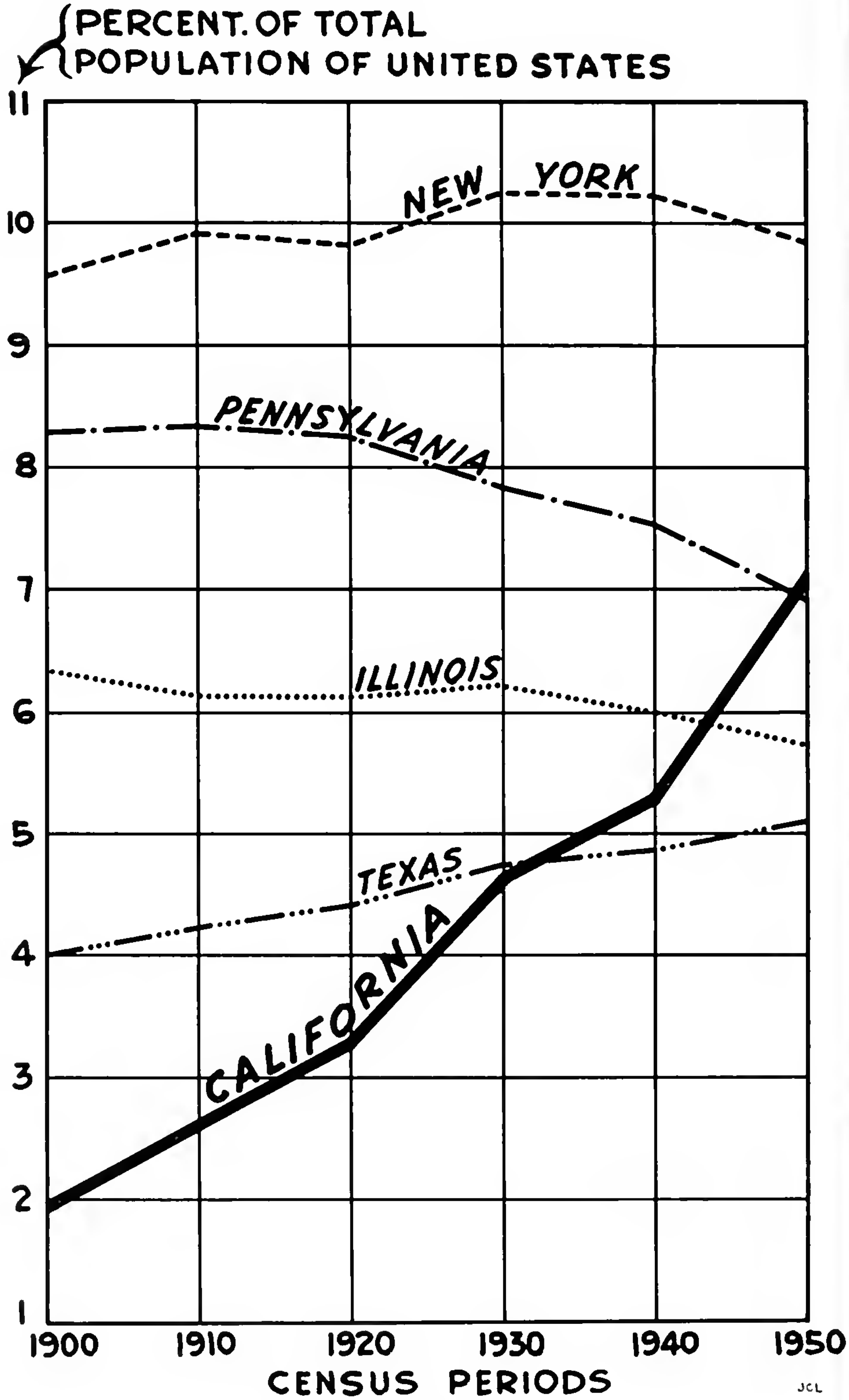
California's Position

The Korean War and threat of further Asiatic and European conflict spotlight California's unique position from a geographic, climatic, and strategic standpoint.

Military establishments and industrial defense plants located in California during the recent war effort evidence the vital part played by California in World War II. Many of these were developed further after the war and now many are being reactivated. The present defense program will undoubtedly increase the number and size of such establishments.

These many defense establishments must be served by highways.

California's highways are traveled by 10,586,000 people. California's highways carry over 5,000,000 motor vehicles—highest in the Nation.



California's highways are one integrated system of access roads essential to the defense effort.

In fact, California's highways are a major portion of the United States' defense and assembly lines.

Provision must be made for the allocation of necessary steel and other material, equipment and manpower to carry on a continued program of highway construction if California is to participate effectively in the Nation's defense.

There is advanced herewith factual data supporting the recommendation that California be accorded preferential treatment to continue the State's highway modernization program.

California Is Unique Among the States

Geographically, economically, industrially, and in transportation California is unique among the states. In area it is the second largest state, exceeded in size only by Texas. Its shore line comprises over one-half the Nation's coastal boundary on the Pacific Ocean, thereby making California the principal gateway to the vast Pacific Basin. Its terrain is such as to lay down definite controls for agricultural and urban development and for location of lines of transportation. Over much of its area mild climatic conditions are most favorable to year-round activities unhampered by meteorological extremes.

In the western expansion of the Nation, the sum total of these and other desirable features have attracted large numbers of people to the Pacific slope. One hundred ten years ago, California was merely the name of the last western frontier, surrounded by legendary yarns of subtropical climate, arid deserts, and snow-capped mountains. Today, a bare century since the days of those legends, California's 1950 population of 10,586,000 is second only to the State of New York. This century of growth from a handful of Indians and native Californians, plus a few dozen Americans, to 10½ million people, is probably unprecedented for any similar area in the world. The population of this State in 1860 was less than 400,000; passed the million mark in 1890; was 3½ million by 1920; 5,677,000 by 1930; 6,907,000 by 1940, and now 10,586,000. It should be noted that the population increase of 3,678,000 during the last decade was by far the largest rise in any 10-year period; 53.3 percent over the 1940 population.

California's population increase in terms of percentage of the national population, compared to that of other large states since 1900, is shown on the accompanying chart.

Purcell Writes MacDonald

Coincident with Governor Warren's letter to Director Wilson, Office of Defense Mobilization, Director of Public Works C. H. Purcell sent the following letter to T. H. MacDonald, Commissioner of Public Roads, Department of Commerce, Bureau of Public Roads, Washington, D. C.:

Dear Mr. MacDonald: "Information reaching me regarding mobilization conferences in Washington has indicated that highway officials need take a miltant attitude, if the states are to be accorded treatment which will allow the continuation of highway construction and maintenance programs.

"I know that you are undoubtedly burdened with the task confronting you in your effort to secure material allocations, to enable the states to prosecute their present highway construction work.

"I believe California is destined to play a vital role in any international crisis that may develop. California, in World War II, was a stronghold of military establishments and industrial defense plants vital to the Nation's war effort. Today those same defense plants and military establishments are being reactivated and in many cases expanded.

"California's highways are a large part of the State's defense and assembly lines.

"I wish to impress upon you that California has the greatest stake of any of the states in the need for continuing highway development during a war period.

"I have prepared, and direct to you herewith, a report emphasizing the importance of California's highways in the national defense effort. I should appreciate your using this material to urge that California be given special consideration in the allocations of necessary steel and other materials, to permit a continued highway construction program in this State."

California's Phenomenal Transportation Development

A factor of greatest importance in the story of California's phenomenal growth is the corresponding story of transportation development. The great increases in population in this State came after the era of railroad expansion and during the period of contraction of rail facilities. In fact, as far as California is concerned, railroad development never approached eastern and midwest standards commensurate with equivalent population.

The result has been that, ever since the days of the gold rush, the entire economic life of California has been more dependent upon road and highway transportation than any comparable eastern or midwest area. During the past 30 years appreciable reductions in California's meager rail facilities have accentuated this economic and social dependence upon the State's highways.

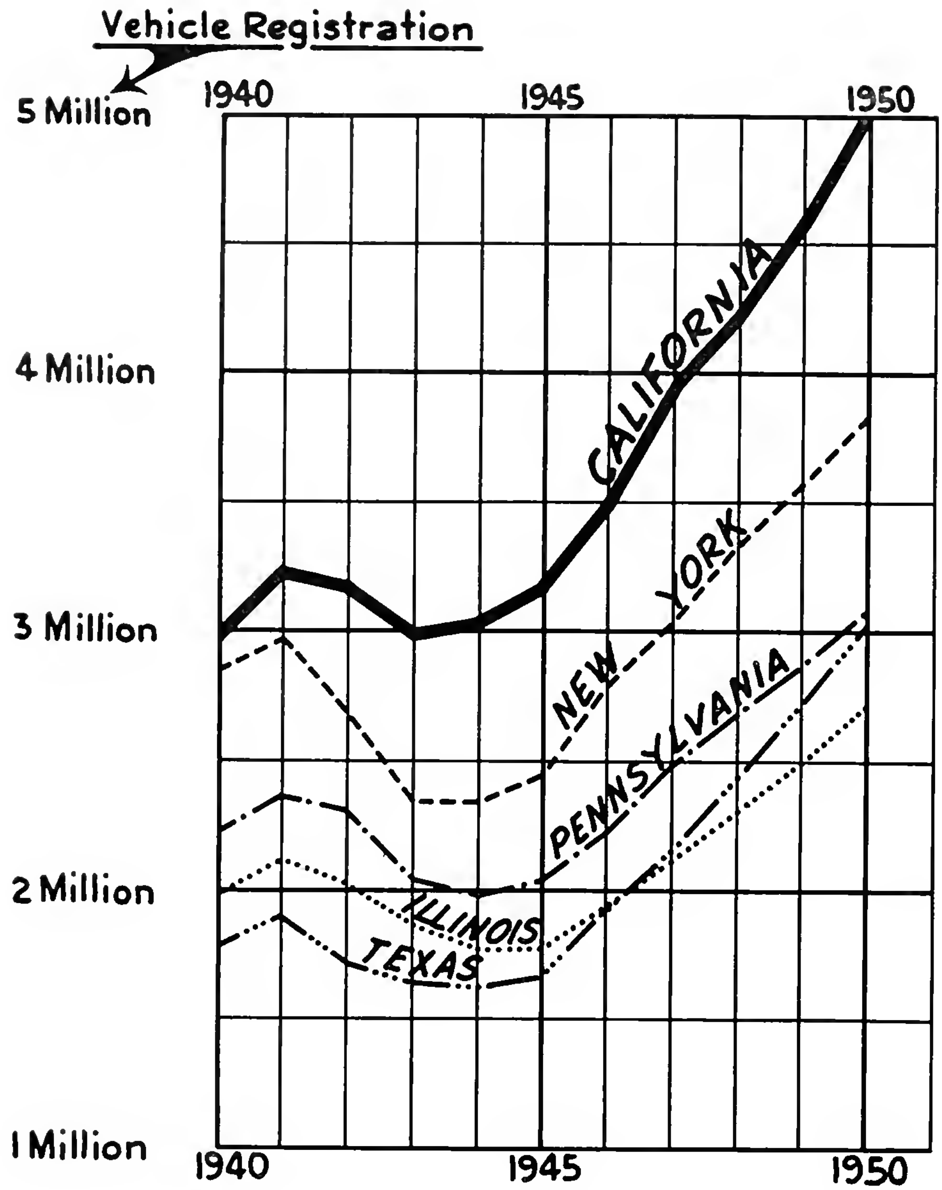
With each decade this dependence upon highway transportation was emphasized by the accelerating growth of population. The rapid development of automotive transportation placed further emphasis on the need for highway facilities. In 1920 there were 604,000 vehicles registered in California; by 1930, the number was 2,136,000; by 1940, it was 2,990,000; and today it has passed the 5,000,000 mark. Considering the 10½ million population, 5,000,000 vehicles means one vehicle to every two persons. Thus the highest total registration and highest per capita registration of any state are in California, where economic life and defense activities are vitally dependent upon highway transport.

The accompanying chart of motor vehicle registration clearly indicates California's position during the past 10 years in relation to states of comparable size. California's dependence upon motor transportation was brought into sharp focus by activities in World War II.

Some of the reasons why California is the Nation's most heavily motorized state may be found in a detailed examination of the services rendered by the highway transportation system to certain basic industries, to government and to city life. During times of emergency these services become vital.

Agriculture

One of the fundamental reasons for establishing and maintaining road systems is to serve the needs of agriculture. The farmer's ability to produce and to distribute his products in support of the de-



DEFICIENT MILEAGE TO BE COMPLETED AFTER 1951-52 FISCAL YEAR ON PRINCIPAL STATE ROUTES

		Miles
U. S. 99		
Los Angeles to Sacramento		239
U. S. 101		
Mexican Border to San Francisco		442
Includes Santa Ana Freeway	45 miles	
Includes Hollywood Freeway	3 miles	
U. S. 60, 70, 99		
Ramona Freeway (Los Angeles to Colton)		43
U. S. 6		
Harbor Freeway (Los Angeles to San Pedro)		22
U. S. 50		
San Francisco to Stockton		55
State Rt. 14-69-5		
Carquinez Bridge-East Shore Freeway-San Jose		51

AVERAGE DAILY TRAFFIC ON PRINCIPAL STATE ROUTES

Route Section	ADT
U. S. 99 (Rt. 4)	
Sacramento-Stockton	8,000
Stockton-Modesto	8,500
Modesto-Fresno	10,500
Fresno-Bakersfield	9,000
Bakersfield-Los Angeles	8,500–11,000
U. S. 101 (Rt. 2)	
San Francisco-Palo Alto (Bay Shore)	30,000+
Palo Alto-San Jose	16,000
San Jose-Salinas	10,500
Salinas-Santa Barbara	4,500– 5,000
Santa Barbara-Ventura	5,000–11,000
Ventura-Camarillo	6,000
Camarillo-Calabasas (Los Angeles City Limit)	9,000
Hollywood Freeway	73,000
Los Angeles-San Diego	14,000–20,000
U. S. 66 (Rt. 26)	
Ramona Freeway	40,000
Rt. 165	
Harbor Freeway	84,000 Est.
U. S. 40 (Rts. 69 and 14)	
Carquinez Bridge-East Shore Freeway	28,000–60,000
U. S. 50	
San Francisco-Stockton	10,000

fense effort is directly dependent upon the availability of good highway transportation.

This is particularly true in California, the richest agricultural state in the Union, where large-scale farming operations are highly mechanized and high-volume production of many crops is the rule. The arable lands of the State, together with the climatic condition and water to make them productive, constitute the foremost of the State's natural resources. Its 133,000 farms embrace an area of 30,500,000 acres, of which about 7,000,000 are suitable for crop production, with 5,000,000 acres under irrigation. Value of these farms exceeds two and one-half billion dollars.

The principal crops—fruits and nuts, field crops, vegetables, livestock and poultry—weigh some 30,000,000 tons annually. All this moves on wheels at some part of the journey to markets, canneries, warehouses, railroad sidings, airports, processing plants or points of consumption. Some of it is handled only once, but much of it requires several handlings.

As the output of California farms has grown consistently through the years, highway transportation has demonstrated its capacity to expand as increasing demands have been made upon it. The role of the highways in handling the movement is reflected in the rapid increase in the number of trucks in service during the period. Thirty percent of the 500,000-plus trucks registered operating in this State directly serve agriculture.

Perhaps the most critical service rendered to agriculture by the motor truck is in the case of perishable products, which must be moved quickly and at the proper time to prevent loss. Here the mobility of the motor vehicle is an essential factor.

The fact that highways form a network connecting every community in the State, and tie into interstate routes, is of basic significance to agriculture, because producing areas are spread over almost every part of the State's 156,803 square miles, with the exception of extreme mountainous sections and the unirrigated parts of the southeastern desert. Farm products may be

hauled to any desired marketing or shipping point.

This dependence of agriculture on the highways will be accentuated as the Central Valley Project, Imperial Valley canals and other irrigation developments bring more land under cultivation.

In California, 84 percent of all rural dwellings are directly served by improved roads, and 97 percent are within one mile of surfaced highways.

Industrialization of California

Industrialization of California was proceeding at a rapid pace even before the tremendous impetus provided by World War II. Value of the State's manufactured products multiplied more than eight times between 1904 and 1939, and in the latter year, California ranked seventh in the Nation in this respect. By 1943, with war production in full swing, the value of her manufactured products was 10½ billion dollars, or three and three-fourths times that of 1939. In the face of the present crisis, with California's population up to 10½ million, an equivalent additional increase is anticipated.

Development of transportation facilities was a factor in the changing character of manufacturing as industrialization proceeded. Forty years ago manufacturing was largely the processing and fabrication of products of the region. Now half the activity consists of products for the local, regional and national market fabricated from raw or semifinished material imported into the State.

The extent to which highway transportation contributed to this industrial development was brought sharply into focus at the time the Nation's resources were marshalled for World War II production. As plants were established or expanded, many of them depended entirely or in large part upon roads for the movement of raw materials and finished products. Even if rail or water connections were available, there was considerable dependence upon trucks. At the present time this dependence had increased.

Location and size of plants were determined to a considerable extent by the availability of automobile transportation for workers. In the Los Angeles area, one of the Nation's greatest war production centers, 80 percent of the half-million war plant employees got to work by automobile. One large aircraft plant found that 92 percent of its personnel rode an average of 11 miles daily from home to work in their own cars. A continuing shortage of housing in industrial areas makes it necessary for thousands of workers to live beyond the limits of districts served by public transit systems.

As California goes forward into a new period of industrial development and defense production, highways will become increasingly important as arteries of commerce. Every type of motor vehicle will play a part in the transporting of raw materials, equipment and personnel to the factories, and in the distribution of manufactured goods. Trucks must be used to haul freight to and from the waterways, railroads and airports. Distribution of commodities to the door of the consumer is almost entirely the job of the motor vehicle, which, in turn, is dependent upon adequate roads and streets for efficient operation.

Industries vital to defense production, while more concentrated in metropolitan areas, are, nevertheless, widely spread. Relatively few of such industries are situated so as to rely upon means other than highways for access.

Production of Petroleum and Natural Gas

The production, refining and marketing of petroleum and natural gas constitute one of California's most vital defense industries. California has approximately one-sixth of the Nation's oil reserves and a substantial proportion of the natural gas. Petroleum products are high on the list of the State's exports, both in volume and in value.

Oil and gas are the principal fuels used by industry in the State, and will increase in importance as defense manufacturing develops, particularly since California has no large coal deposits. Petroleum also is the basic material for thousands of products of the chemical and allied industries.

Unlike other oil-producing areas in the Nation, production, refining and marketing in California are carried on within the same areas in some parts of the State, particularly in the southern counties. This reduces the dependence on long-distance transportation of the products by pipe line and tank car and increases the importance of transportation by truck. Thus highway transportation in California performs a vital service to the oil industry, particularly under defense conditions.

MacDonald Writes Purcell

Director of Public Works C. H. Purcell was encouraged by a letter he received from Thomas H. MacDonald, Commissioner of Public Roads, Washington, D. C., commenting on the report Purcell made to him urging that there be no curtailment of critical materials required to continue California's program of highway construction for national defense.

"Your report," MacDonald wrote, "portrays in a very comprehensive and effective manner the vital necessity of providing for a continuing large-scale program of highway construction and maintenance if California's highways are to be improved and preserved in a condition to adequately take care of the defense and civilian economy needs.

"You may rest assured that every reasonable effort is being made by those of us who are constantly in contact with the situation here, to stress the vital importance of highways to the National defense and the essential civilian activities without which the success of the defense effort would not be possible. Conferences have been held frequently with representatives of the Defense Production Administration and National Production Authority in an endeavor to make certain that the necessary materials and equipment will be made available to take care of highway requirements.

"The National Production Authority expects to have a controlled materials plan in operation by July 1, 1951. It is hoped that when the plan is put into effect a definite allocation will be made of the necessary materials for carrying on an adequate highway construction and maintenance program. Until then, however, it is necessary to submit each individual project to the National Production Authority for consideration on its own merits. We have been quite successful, to date, in obtaining priority assistance when adequate supporting data have been submitted to show a definite relationship to the National defense or that severe hardship would result if the project were not completed."

Mining

Mining was the industry responsible for California's initial prosperity after gold was discovered nearly one hundred years ago, and some of the State's first roads were built to accommodate ore wagons and stages carrying gold dust and bullion.

Mining has continued through the years to be an important factor in the State's economy. The output in 1941 weighed approximately 79 million tons, and as almost all of it was transported by truck at some stage of its processing, the tonnage is a rough index of the dependence of the industry on the highway system. California produces commercially a greater number and variety of mineral products than any other state, many of which are necessary to defense production.

Lumbering

Particular importance attaches to California's forest resources in the present critical period of heavy demand for building materials by the construction industry. California produces over 4 billion board feet of lumber annually. Lumbering operations now are conducted largely on a selective basis, with available timber existing in small, scattered tracts rather than in large stands. This makes it economically impractical for private enterprise to construct logging railroads, as was the practice in the past, to move timber from forest to sawmill.

In recent years increasing use has been made of tractors and trucks, both for hauling logs to the mills and in transporting lumber to the point of use or export. Thus highways and access roads are an important factor in determining the State's output of lumber.

California Highly Urbanized

It is significant that California has become a highly urbanized state during the period in which motor vehicles have come into widespread use and modern highways have developed.

The current expansion of California's cities into adjacent outlying areas is predicated to a large extent on the mobility of highway transportation. Many workers now reach central business and manufacturing districts easily from suburban residential areas.

In 1900, 52 percent of California's population was urban, and by 1940 it was 71 percent. Changes resulting from the war have made the percentage of metropolitan dwellers even higher.

The State's seven metropolitan districts—Los Angeles, San Francisco-Oakland, San Diego, Sacramento, San Jose, Fresno, and Stockton—are quite widely separated. It is the function of the highway system to provide a convenient means of travel between them, and to give their residents easy access to rural areas of the State. Food, raw materials for manufactures, and most other commodities necessary for maintaining the life of the cities flow in over the highways. Manufactured goods move out to markets.

California cities are heavily dependent on highways for their supplies of food. Trucks bring in six billion pounds annually, completely supplying the needs of Los Angeles, San Francisco, San Diego, Sacramento and other communities, large and small.

Even as early as 1941, trucks carried more than 85 percent of the fruits and vegetables sold in the Los Angeles market, and more than 69 percent of the total consumed in San Francisco.

Inadequacy of Mass Transportation Facilities

One hundred California cities, constituting 60 percent of those over 2,500 population, are not served by local mass transportation systems. In such cities, residents rely heavily upon automobiles. In cities where mass transportation systems operate, they handle only 20 to 40 percent of the total travel.

Out of 48 major local transit systems, 41 use busses exclusively, one is all rail, and six use both bus and rail. Nearly half of all transit system passengers are carried by bus. This ratio is increasing as street railways are gradually being abandoned in favor of more modern and efficient motor transportation.

The high per capita ownership of motor vehicles in California cities is a significant index of the dependence of the cities on this type of transportation.

Highways in an Emergency

Within a city the administration of police and fire protection, schools, public works, courts, health and welfare services is largely dependent upon the convenient transportation afforded by streets and highways. If because of an emergency, such as atomic or conventional bombing attack, a city's street system temporarily ceases to function, chaotic conditions may result.

Networks of highways, by tying together the scattered elements of each unit of local, state and national governments, make it possible to provide public services affecting almost every phase of human activity. Highways and streets bring the government to the people.

Highways and the Federal Government

While many functions of the Federal Government also involve the Nation's highway transportation system, the most important example is national defense. Roads are essential for transporting troops and supplies to strategic locations, and for maintaining forts, camps, air fields, harbor defenses and all other types of military installations. Rural delivery of mail, a federal responsibility which is discharged via highways, provides a regular and reliable means of communication for even the most isolated farm. Movement of mail within the cities from train and airport to post offices is largely accomplished by trucks.

Throughout the West, and particularly in California, administration of national forests, parks and monuments, grazing districts, reclamation projects, Indian reservations, power development and navigation involve large-scale federal activity, all concerned with the development and maintenance of roads to serve areas of operation.

California's Interstate Traffic

Interstate traffic, while a relatively small proportion of the total in California, is increasing rapidly, and the effect of World War II on that phase was most notable. During the five years of the war, the number of foreign cars entering California increased 64 percent, and the number of foreign trucks increased 42 percent; however, foreign busses increased 124 percent and bus passengers increased 225 percent.

A LUCKY DRIVER AND A HARDY TRUCK

THE ACCOMPANYING photographs graphically depict an unusual accident which occurred on Sign Route 49 near Ramshorn Creek about eight miles from Downieville in Sierra County on February 14th, last.

A Division of Highways truck operated by J. P. Poggi was hauling fill material from a three-quarter cubic yard power shovel to restore embankment lost during the heavy November storms. The edge of the embankment gave way before the truck was in position to be dumped. The driver stepped off as the truck went over backwards.

As indicated by the photographs, the truck came to rest on its tailgate on a small ledge of rock. The truck was in such a precarious position that it was necessary to use extreme care in attaching a tow line. The bucket of the shovel was used to carry Highway Foreman Chester Butz out to attach the tow line. A high line was rigged and two loaded trucks were used to assist the shovel in salvage operations.

The only damage to the truck was a broken headlight lens, which damage was caused by the tow cable during salvage operations.

The photographs were taken by Highway Superintendent A. C. Irish.

UPPER LEFT—Truck lands on its tailgate on small ledge of rock. UPPER RIGHT—Foreman Chester Butz attaches tow line. LOWER—Undamaged truck is ready to resume operations.

California, Bridgehead to the Far East

During World War II California's position from the defense standpoint of any war involving the Pacific Basin was clearly indicated. California, being the bridgehead to the Far East, immediately became the preferred location for sites not only of military and naval establishments, but also a wide variety of defense industries. This fact was one of the prime factors in the State's phenomenal growth during the past year.

Today the Korean war and threat of further Asiatic and European conflict spotlight California's unique position from a geographic, climatic, and strategic standpoint.

Military establishments were scattered throughout the State and in case of current and future defense preparation, the reactivation of these establishments, plus a considerable percentage of increase is an obvious conclusion. Access to these establishments is almost entirely by highways.

. . . Continued on page 61

Traffic Interchange Design

By SAM HELWER, Assistant Engineer of Design

This is the third and last of three articles by Mr. Helwer—Editor.

1. A. A. S. H. O. Minimum Safe Radii Table

IN THE DESIGN of all freeway ramp connections, California practice makes use of the A. A. S. H. O. table for minimum safe radii for various speeds. It

A. A. S. H. O.
Min. Safe Radii for Various Speeds

Turning Speed V	20	30	40	50
Design Coeff. of Friction f	.54	.43	.33	.25
Assumed Superelev. E	0	.05	.10	.10
Min. Safe Radii	50	130	250	500

$E+F=.067\frac{V^2}{R}$

will be noted that the friction factor varies from 0.54 at 20 m.p.h. and a radius of 50 feet to 0.25 at 50 m.p.h. and a radius of 500 feet. For conventional highway design, California has always used a friction factor of 0.16 for speeds between 20 and 60 m.p.h. The use of the higher friction factors have been questioned by some authorities, including Professor Ralph A. Moyer, whose original tests were used by the A. A. S. H. O. in the development of this table.

Although it is reasonable to assign a higher friction factor for the lower speed range, it appears that factors of 0.54 and 0.43 are too high. To show the increase in radii with reduced friction factors, the A. A. S. H. O. table has been recalculated here using a friction factor of 0.16 with 12 percent superelevation. The increase in radii is from a 50-foot to a 100-foot radius at 20 m.p.h. and from a 500-foot to a 600-foot radius at 50 m.p.h.

Effect on Design

Assuming that we were to change our friction factor for ramp design, what effect would this have on design? For the 40 and 50 m.p.h. ramps, the change in right of way and construction costs would usually only be nominal. In many cases there would be *no* change, because wherever possible, the designer already uses radii larger than the minimum for each design speed classification.

Minimum Safe Radii for Various Speeds
FOR COMPARISON PURPOSES ONLY
CALCULATIONS BASED ON O.16 FRICTION FACTOR AND O.12 SUPERELEVATION

TURNING SPEED |V|	20	30	40	50
ASSUMED FRICTION |F|	.16	.16	.16	.16
ASSUMED SUPERELEV |E|	.12	.12	.12	.12
CALCULATED SAFE RADII	100	215	385	600
A A S H O RADII	50	130	250	500

For the 20 and 30 m.p.h. designs, however, there would be complications. In the first place, these lower design speeds are only selected because of critical topography and right of way limitations. An increase in radius here could increase costs materially. If the radius cannot be increased, the other alternative would be to increase lengths of speed change lanes.

Exact calculations showing what these increases would be are not available, but enough investigation has been made to show that these increases would be small. The greatest increase would be on an acceleration lane for the 50-foot radius. With a 0.16 friction factor and no superelevation, the safe speed for a 50-foot radius is 11 m.p.h. Therefore, an acceleration lane for a 50-foot radius would have to be long enough to go from 11 m.p.h. to 42 m.p.h., instead of 20 m.p.h. to 42 m.p.h. The difference, which is the distance to go from 11 m.p.h. to 20 m.p.h., is in the neighborhood of 100 feet. On the deceleration lane, the increase in length would be materially less.

On the basis of the relatively small increase in speed change length required by using a lower friction factor, and the fact that there are several assumptions and variables in the original calculations of speed change lanes, it does not appear necessary at this time to change our design standards. Furthermore, actual operation on many completed projects has not yet demonstrated the need for revision. We have had some difficulties on short radius off-ramps which should be expected at any location where a transition from a high standard facility to a much lower design standard is necessary.

Avoid Minimum Design Standards

The preceding discussion of friction factors has been made for one particular purpose. Although it appears there is no serious error in assigning relatively high friction factors for the determination of safe radii for ramp speeds, it is essential that the designer realizes the recommended radii are *absolute minimums*. Absolute minimums should be used only where absolutely necessary. As an example, if it is not possible to obtain 30 m.p.h. (130′ R) design on a given ramp, it should not be necessary to drop to a 50-foot radius in going down to a 20 m.p.h. ramp. The largest radius possible under 130 feet should be used instead.

Lengths of Speed Change Lanes

The lengths of speed change lanes for various ramp design speeds have been standardized as shown in the following table. These lengths are essentionally the same as the recommendations contained in the A. A. S. H. O. pamphlets.

The assumptions made in setting up the lengths for acceleration lanes should be clearly understood. These auxiliary lanes are designed strictly on the basis of accelerating from the safe speed of the ramp to the assumed merging speed of the freeway. It is assumed

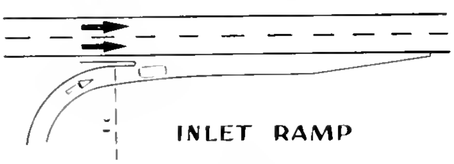
SPEED CHANGE LANES AND TAPER (LENGTHS)

		HIGHWAY DESIGN SPEED V mph				
		30	40	50	60	70
Av Speed of Travel (0.7V)		21	28	35	42	49
		TAPER (feet)				
Deceleration		90	120	150	180	210
Acceleration		150	180	240	270	300
Ramp Speed	Min Radius	DECELERATION LANE Including Taper				
20	50	90	140	225	295	395
30	130	90	120	150	235	315
40	250		120	150	180	240
50	500			150	180	210
		ACCELERATION LANE, Including Taper				
20	50	150	180	410	750	1180
30	130	150	180	240	510	950
40	250		180	240	270	550
50	500			240	270	300

that a merging vehicle will be able to enter the through traffic stream when the merging speed is reached. As the traffic volumes build up, both on the ramp and the through facility, it may become necessary to provide additional length for merging. This additional length will be a function of traffic volumes. More research and data are necessary in this field before we can change our acceleration lanes to merging lanes, which is actually the function they must perform.

2. Freeway Inlets

Some of the most important features of a freeway ramp, are the shape and width of the ramp throat at its connection to the through lanes. From observation of traffic behavior, it has been determined that an inlet ramp throat must be designed in such a manner that it will be easier for the driver to use the acceleration lane which has been provided than it would be to cut directly into the freeway lane ahead

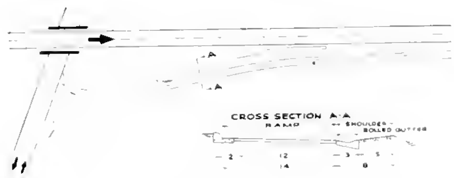

INLET RAMP

of the inlet nose. This is accomplished by designing ramp alignment which brings the entering vehicle into a position on the acceleration lane parallel to the through traffic lane.

The throat width of an inlet ramp should permit only single lane operation because acceleration lanes are designed to accommodate only single lane operation. The inlet throat is that point on a freeway inlet where the ramp proper ends and the acceleration lane begins. Two-abreast operation at an inlet throat would necessitate direct entry into the freeway lanes by one of the vehicles without proper acceleration. This would result in confusion and hazard to all traffic.

Single Lane Operation

This desired single lane operation pertains to the entire length of the inlet ramp except at the connection to the city street. At the connection to the city street, provision should be made for both right turns and left turns from the city street, where the interchange layout permits such turns. A well-designed inlet ramp can handle up to 1,500 cars per hour by actual count, which is a higher volume of traffic than most city streets can funnel into such a ramp. In the past, we have constructed some two-lane inlet ramps which were choked to one lane at the inlet throat. This has proven to



SINGLE LANE INLET
WITH EMERGENCY PARKING SHOULDER
Widened at Street Connection to Permit Simultaneous Left and Right Turns

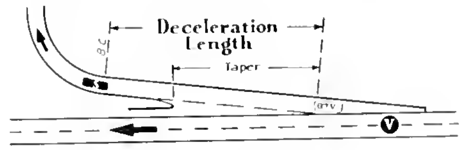
be undesirable because of the inevitable racing for position at the inlet throat, resulting in the fender-denting type of accident at the point of constriction.

Although it is desirable to induce single-lane operation on an inlet ramp, it is also necessary to provide additional width for emergency passing of a stalled vehicle. The most effective way to provide this emergency parking shoulder is by use of a three-foot rolled gutter design on the right of a 14-foot traffic lane. The rolled gutter, plus an additional five-foot width of treated shoulder, provides an all-weather parking shoulder, and yet discourages two-lane operation on the ramp.

The rolled gutter emergency parking shoulder is generally used in urban areas and particularly on metropolitan freeways. In rural areas the emergency parking shoulder on the right of a ramp traffic lane usually consists entirely of a treated shoulder.

3. Freeway Outlets

The shape and width of an outlet ramp must also be given careful consideration. In our earlier designs, it was accepted practice to provide a decelerating lane parallel to the through pavements. Observations on completed projects quickly demonstrated that

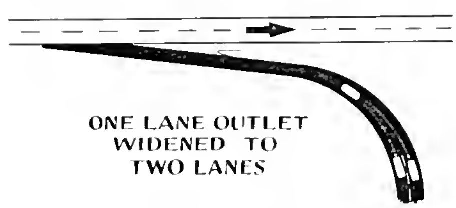


V = Freeway Design Speed
S = Safe Speed of Ramp

traffic will not pull over into a parallel lane to decelerate, but will instead take the most direct path into the outlet ramp throat. The standard outlet ramp design now being used takes traffic from the freeway in a straight line into the ramp throat.

The width of an outlet ramp throat should also accommodate only single lane operation, and this single lane movement should be induced from the right-hand freeway lane. If a ramp throat is wide enough to accommodate two-lane operation, traffic may be induced to turn from the left and center lanes as well as the right-hand lane, resulting in a hazardous conflict with through traffic.

The capacity of a well-designed single-lane outlet ramp will also accommodate about 1,500 vehicles per hour. This volume is in excess of the volume which can be handled on an ordinary city street. For this reason, where outlet volumes are high, it is frequently necessary to widen an outlet ramp to two lanes beyond the ramp throat to



provide storage room for vehicles waiting to enter the city street or local road and in order to prevent the backing up of traffic on the freeway lanes.

4. Ramp Grades and Vertical Sight Distance

The successful and safe operation of any inlet or outlet ramp is also greatly dependent on the grade line and vertical sight distance of the ramp. Inasmuch as the inlets and outlets of a freeway are the points of concentration of all turning movements to and from the freeway, it is highly necessary that adequate sight distances be provided. Sight distances should not only be adequate for safe stopping maneuvers, but should also provide an advance view of the interchange facilities to aid the driver in selecting the proper interchange connection.

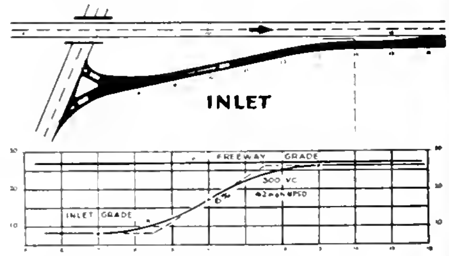
Ramp grades generally should not exceed 6 percent. In special cases, they may be as high as 8 or 10 percent. The grade rate of a ramp, however, is usually not as critical as the sight distance at each end of the ramp.

The grade of an outlet ramp usually ascends or descends relative to the through pavement lanes. If the ramp departs from the through pavement on an ascending grade, there usually is no problem of sight distance at the point of departure of the ramp. The ramp takeoff, and the ramp itself, is clearly visible to approaching traffic for a sufficient advance distance to be impressed on the vision of the driver. The ramp pavement lying in plain view of the driver is a more effective visual aid than any directional sign which might be erected.

Descending Outlet Ramp

Outlet ramps which depart from the through pavement on a descending grade are a different problem. In designing the grade line of a descending outlet ramp, it is advisable not to start the vertical curve so close to the outlet nose that the entire ramp pavement is hidden from view of the driver until he is within two or three hundred feet of the ramp throat. Instead, the ramp grade line should be designed so that the ramp pavement and the through pavement are in about the same plane for a reasonable distance beyond the outlet nose, before starting the downward roll off the ramp.

Sight distance at freeway inlets may also be critical if the through traffic and the entering traffic are not visible to each other for some distance preceding the inlet throat. An inlet ramp that brings entering traffic up to the level of the through lanes in the manner of an express elevator can have a disconcerting effect on both through and entering traffic. The ramp grade should be designed to permit the two lines of traffic to run alongside of and in full view of each other for a short distance before reaching the inlet nose. Ramps constructed in this manner, with a 100-200 foot parallel portion of ramp pavement ahead of the inlet nose, are



operating very smoothly. This permits the two streams of traffic to pace each other and gives the entering traffic an added distance to select a space gap in the through traffic for safe merging.

5. Left-side Connections

No discussion of speed change lanes and ramps is complete without mentioning left-side connections. Left-side interchange connections have been a controversial feature of design. Some authorities on interchange design have recommended against designs which take interchange traffic from the through lanes on the left side, or which bring entering traffic into the through lanes on the left side.

Two arguments have been presented to support this viewpoint. The first is that the left lane of a freeway is the high-speed lane while the right lane is the slow-speed lane. The other is that all connections to freeway lanes should be made on the same side of the freeway for the sake of uniformity of design and development of uniform driving habits.

Limited observations of the relative speeds on California freeways on the left, center and right lanes have not been conclusive. Speed checks by lanes on the Arroyo Seco Parkway during peak hours indicate there is no appreciable difference in speed on any of the three lanes. Speed, however, is directly related to distribution and volume of traffic, and will necessarily vary as the volumes vary. On freeways nearing practical capacity there is apparently little difference in speed on the various lanes, while facilities whose capacities are not yet approached may show higher speeds in the left lanes.

Example of ascending outlet on Arraya Seco Parkway between Los Angeles and Pasadena

Uniformity of Design

Uniformity of design and development of uniform driving habits is a highly desirable goal which has not yet been reached. It is also doubtful that complete uniformity of design will be achieved in the near future, except insofar as uniformity of a particular interchange design type is concerned. Because of economic reasons, all of the various interchange types now being used have a definite place in the freeway system.

While it might be desirable from the standpoint of uniformity to make all connections to a freeway on the right side, there are locations where the more economical, more natural and more direct characteristics of a left-side connection outweigh the theoretical disadvantage of a departure from uniformity of design. This is particularly true of the direct type interchanges; in fact, it is the single characteristic that distinguishes a direct interchange from an indirect interchange.

There are more than a few examples of existing left-side connections on the California Freeway System. Some of them are constructed to design standards that are now obsolete but, in spite of this, are operating safely under heavy traffic volumes. As an example, there are three left-side off-connections on the Arroyo Seco, all within a short distance of the tunnel section on this parkway. They are the Castelar, Riverside and Figueroa off-ramps.

From the experience records of existing left-side connections, it is reasonable and safe to say they have a definite and useful place in freeway design, particularly as a part of a direct interchange.

EMERGENCY PARKING SHOULDERS

The necessity of providing emergency parking shoulders on structures and ramps, particularly on one-way one-lane roadways, has been discussed in preceding paragraphs. Similarly, it is highly desirable to provide continuous emergency parking shoulders on the right of the freeway traveled ways. As stated previously, a vehicle stalled in a traffic lane not only introduces traffic hazards, but also reduces traffic capacity.

At the time the Arroyo Seco Parkway was constructed, no shoulders of any kind were provided. The right edge of the traveled way was curbed continuously with an eight-inch barrier type curb. Due to difficult topographic controls, right of way widths were extremely critical. In general, the parkway parallels the concrete-lined channel of the Los Angeles River, and in some instances the edge of the outbound pavement is less than shoulder width from the top of the river channel.

Operation on this parkway has clearly demonstrated the need for emergency parking shoulders. The district has carefully studied this parkway, and wherever possible, has removed the barrier curb on the right and provided emergency parking bays. Although these bays are placed at irregular intervals and are of irregular lengths, observations indicate they are being used and are effective.

As a general rule, the emergency parking shoulders on an urban or metropolitan freeway should consist of a three-foot rolled P. C. C. gutter plus additional width of treated all-weather shoulder. In rural areas the emergency shoulders should generally omit the P. C. C. rolled gutter and substitute full width treated shoulders.

FREEWAY SIGNS

Another very important feature of any completed traffic interchange is proper signing and striping. Due to the high speeds on a freeway, it is essential that directional signs be large enough to be easily noticed and read both day and night. The message should be simple and direct, and, wherever possible, should indicate not more than two choices of direction.

The geometric layout of an interchange should include a signing layout before final approval is made. It is possible that the signing requirements may disclose a design deficiency that would not show up until later. If a layout cannot be signed properly, operating difficulties will result.

Advance warning signs are extremely important on a freeway to aid in segregating the traffic into its proper lanes before reaching a point of interchange. At present, interchange signs are placed at three locations. The first set of signs is placed one-half mile in advance of the off-ramp, one on each side of the freeway. Eight-inch, uppercase reflectorized letters on a black background are used. The next sign

Left-side Figueroa off-ramp on Arroyo Seco Parkway

of the group is a single sign on the right side of the freeway placed one-fourth of a mile from the turnoff. The last sign of this group is located just ahead of the beginning of the deceleration lane and has 12-inch lower case white letters on a black background.

5. Indirect types are suitable at intersections with roadways of secondary importance.

6. The choice of a particular design type must be based on an analysis of traffic service and cost. The simplest design may be the best design.

This photo shows emergency parking bay on Arroyo Seco

SUMMARY

The items of major importance that have been raised in this paper are briefly summarized as follows:

1. A freeway or expressway development furnishes the most important warrant for a grade separation or traffic interchange. Application of this warrant must consider community service, land use and local street circulation.

2. A complete traffic analysis is mandatory prior to beginning the design of an interchange.

3. A freeway centerline should not be definitely located until the interchange problems have been carefully studied and evaluated along with other factors influencing location. Intersections of more than two roadways should be avoided if alternate location of center lines is at all possible.

4. Direct type interchanges should be designed at major intersections. They should be simplified if possible by sacrificing minor movements at the interchange site to provide direct movements for the major movements.

7. Interchange structures should be carefully studied from the standpoint of traffic service, cost and appearance. Changes in horizontal alignment and roller coaster grade lines on the structure should be avoided.

8. The design of the speed change lanes and ramp connections is of primary importance because these facilities must transfer the traffic loads to and from the freeway with a minimum amount of confusion and congestion at the connections to the local streets. Minimum design standards should be applied only after a careful consideration of traffic service and cost. Adequate sight distance cannot be overemphasized.

9. Left-side ramp connections are warranted if traffic analysis indicates the need and cost studies are favorable, particularly for direct type interchanges.

10. Emergency parking shoulders should be provided wherever practical on structures, ramps and adjacent to main traveled ways.

11. The successful operation of any high-speed facility is dependent to a great extent on adequate, simple and direct signing. The signing should provide advance warning and be easily read both day and night.

CONCLUSION

The Division of Highways has made excellent progress in the relatively new field of interchange design in the past few years and will continue to do so. There is yet much factual data to be gathered on the operating characteristics and capacities of the various types of interchanges. These facts will be gathered as they become available through experience. Observation of completed facilities under operating conditions will undoubtedly point the way to continual improvement.

In conclusion, the importance of interchange design should be stressed. The traffic interchange represents a substantial percentage of the expenditure on freeway construction and is the key to the successful operation of the freeway. The traffic interchange is the mechanism that makes the freeway possible. The freeway, in turn, with its characteristics of relief from delay, congestion and hazard, is the answer to the overcrowded and restricted conditions on many of our outmoded conventional type highways. The freeway removes all these irritations and inconveniences from the community through which it passes and binds the community together again with its grade separations and interchange facilities.

APPRECIATIVE MOTORIST

ABEGG & REINHOLD CO.
Los Angeles, California

California Highways and Public Works
Sacramento, California

Gentlemen: I would not want to miss *California Highways and Public Works*. It has been a pleasure looking forward to it every other month.

Returning recently from an extended trip through the Midwest it was a pleasure to enter our State and enjoy driving on fine highways. Our State Department of Public Works is to be congratulated for the fine job it is doing and the taxpayers for money well spent.

Yours very truly,

W. H. Spiri

Oldest Swing Bridge

Span Built 70 Years Ago To Be Replaced

By ROBERT M. BARTON, Associate Bridge Engineer

THE OLDEST movable bridge on the State Highway System, and possibly the oldest of its type in the State, is to be removed and replaced during 1951. This structure, known as the San Leandro Bay Bridge, is an obsolete swing span which connects the City of Alameda with Doolittle Drive, the Oakland Airport, and the Bay Farm Island residential district of Alameda. It has three trusses; the center truss originally separated the carriage and wagon way on one side of the bridge from a narrow gage railroad on the other. However, both sides are now used for highway traffic.

On April 18th, bids on the new bridge were opened and the Duncanson & Horrelson Co. and Stolte, Inc., Richmond, were low bidders with a proposal of $1,631,057.80.

The material used in the bridge is believed to be wrought iron and was fabricated 70 years ago by the Detroit Bridge and Iron Works. The original drawings, the oldest in the files of the Bridge Department, bear the dates 1880 and 1881. The structure was completed in the latter year. Originally, the bridge was opened and closed by manpower, but when the era of labor-saving devices arrived, an electric motor was installed.

The structure was first built at Webster Street (now the location of the Posey Tube), and was moved to its present site in 1898, being replaced at Webster Street by a more substantial swing bridge. (The latter served until it fell into the estuary following a collision with a Dollar liner in 1925. The subsequent bridge, which carried traffic until the completion of the Posey Tube, is now located across the mouth of the American River at Jibboom Street in Sacramento.)

Relic of South Pacific Coast Railroad

The present San Leandro Bay Bridge is a relic of one of California's most interesting but almost forgoten railroads, the South Pacific Coast Railroad (not to be confused with Southern Pacific Coast Lines), a narrow gage line that operated from Alameda through Newark and San Jose to Santa Cruz. In the 1880's it was a favorite route for visitors to Santa Cruz and the redwoods. A ferry connection was maintained between Alameda and San Francisco.

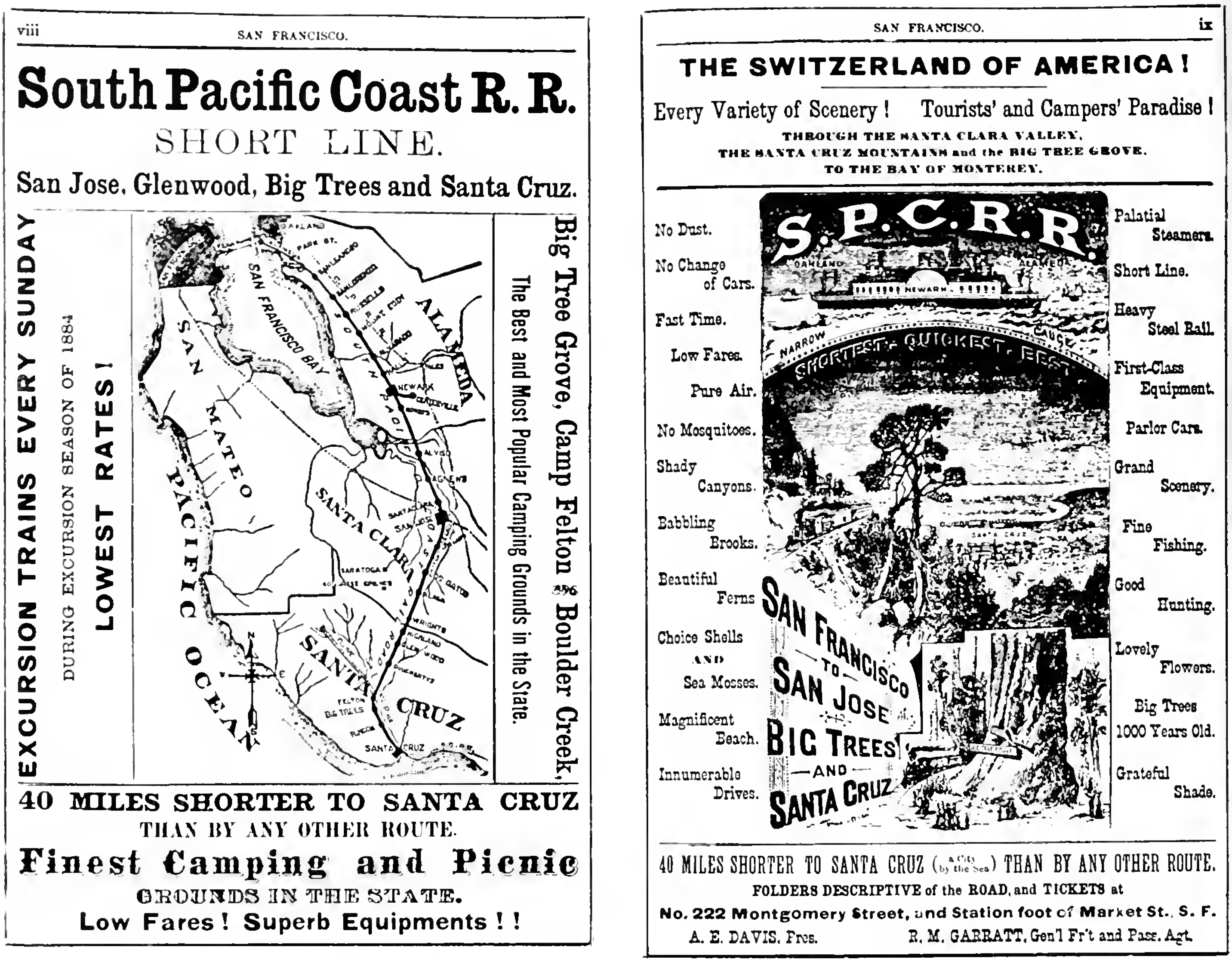
This narrow gage railroad, although small, had large-scale ambitions, for it planned to build southwesterly from Santa Cruz, thence over the Coastal Ranges, and ultimately to connect with the Denver and Rio Grande, a narrow gage line which was extending its lines towards the west from Pueblo, Colorado. However, these plans never materialized.

Since the Central Pacific ferries had a monopoly on ferry service between Oakland and San Francisco, a public clamor arose in Oakland for the South Pacific Coast to build a connection across San Antonio Creek, now known as the Oakland Estuary, so that a competitive San Francisco commute service would be available to Oakland residents. Accordingly, the South Pacific Coast obtained rights to a then existing vehicular county bridge across the estuary at Webster Street, tore it down, and at that time built the swing bridge which is the subject of this article.

Gala Festivities at Bridge Opening

The first train chugged across the new bridge on the evening of May 30, 1881, and there was a "hot time" in Oakland that night. The *Alta California* reported, "Webster Street was brilliantly illuminated . . . for the entry of the narrow gauge railroad. Houses along the street were decorated and illuminated, cannons, fire-arms, and fireworks were discharged, whistles were blown, and a general rejoicing was had." The *Oakland Times*, in its

Originally built by a narrow gage railroad in 1881, this San Leandro Bay Bridge is the oldest of its type in the State



This advertisement, taken from an 1884 San Francisco directory, shows on the left the route of the South Pacific Coast Railroad

report of the festivities, also mentioned Chinese lanterns and bonfires.

The four-wheel coaches of the South Pacific Coast were regarded as very swank indeed. They were constructed at the company's shops in Newark, were finished in prima vera and black walnut, and the seats were upholstered in red plush and had *cushioned* bottoms.

The South Pacific Coast must have proved a strong competitor to the Central Pacific, for the reported travel time to San Francisco from Oakland via the South Pacific's Webster Street Bridge and Alameda Mole route was several minutes faster than via the Central Pacific's Oakland Mole route. It is not surprising, therefore, that the Central Pacific-Southern Pacific interests leased the South Pacific Coast in 1887, thereby restoring its monopoly.

Rail Disaster at Webster Street

On May 30, 1890, a sensational railroad disaster occurred at the San Leandro Bay Bridge, it still being then at its Webster Street location. The bridge had been opened to allow a yacht to pass, and all proper danger and warning signals were posted. The yacht cleared the structure, and the bridge had almost returned to its normal position, when a local passenger train on the narrow gage line, then operated by the Southern Pacific, disregarded the signal, and plummeted into the estuary. Luckily, a coupling on the train broke, so only the locomotive and one coach dropped into the water, two other coaches remaining on the track. Thirteen passengers, trapped in the sunken rail coach, drowned. The engineer, who managed to extricate himself from his submerged cab, was charged with manslaughter for failing to heed the stop signals, but prudently disappeared before any action could be taken.

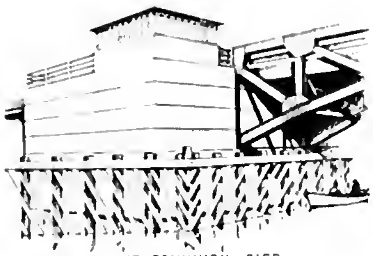
Old Bridge Now Obsolete

The San Leandro Bay Bridge, now approaching its 70th anniversary, is antiquated and has long since passed the point of economical service. It is on poor alignment, and the two traffic lanes provided by the bridge are totally inadequate for the 10,000 vehicles which cross the bridge each day. Consequently, acute traffic congestion often occurs at this bottleneck. The

trusses are very badly rusted throughout, and scaling and deep pitting of the metal are evident over the entire structure; in a few places the webs of the truss members have rusted completely through. The machinery which opens the bridge is not dependable, and has on occasion broken down. The piling supporting the structure are subject to rapid destruction by marine borers (worms). Due to the insatiable appetite of the latter, emergency substructure repairs costing almost $20,000 were necessary in 1949 to prevent the dilapidated bridge from toppling into the Bay when the center pier displayed evidences of tipping.

Bridge Posted

Owing to the deteriorated condition of the bridge, it has been necessary to post the bridge for gross loads of 12 tons and the speed limit for vehicles weighing over 10 tons is restricted to 10 mph. The truss in the center of the roadway has been a contributing factor in several automobile accidents; also, automobile mishaps have occurred as a result of loose deck planking. Furthermore, the present bridge, which limits the clear channel width to 71 feet, constitutes a serious obstruction to the ultimate development of San Leandro Bay as planned by the Port of Oakland. In consideration of all of these various factors, it may be concluded that there is no other bridge in the entire State that has as many outstanding qualifications for relegation to the junk heap.



DETAIL AT TRUNNION PIER

CONTROL HOUSE DETAILS

DETAIL AT END POST

CONCEIVABLE DEVELOPMENT

SAN LEANDRO BAY BRIDGE

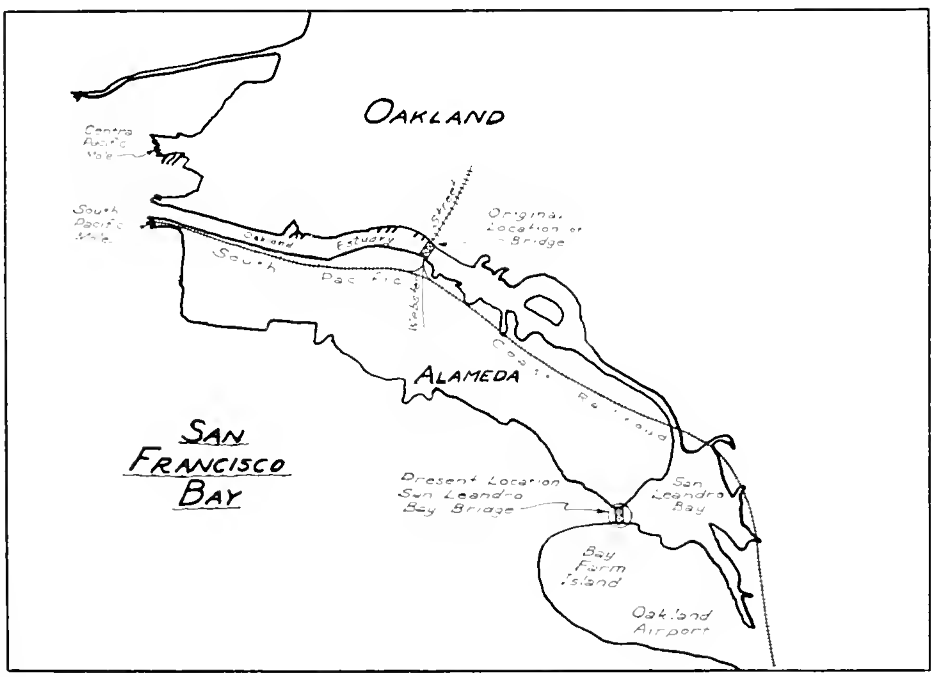
Architect's drawing of new bridge to be built in1951

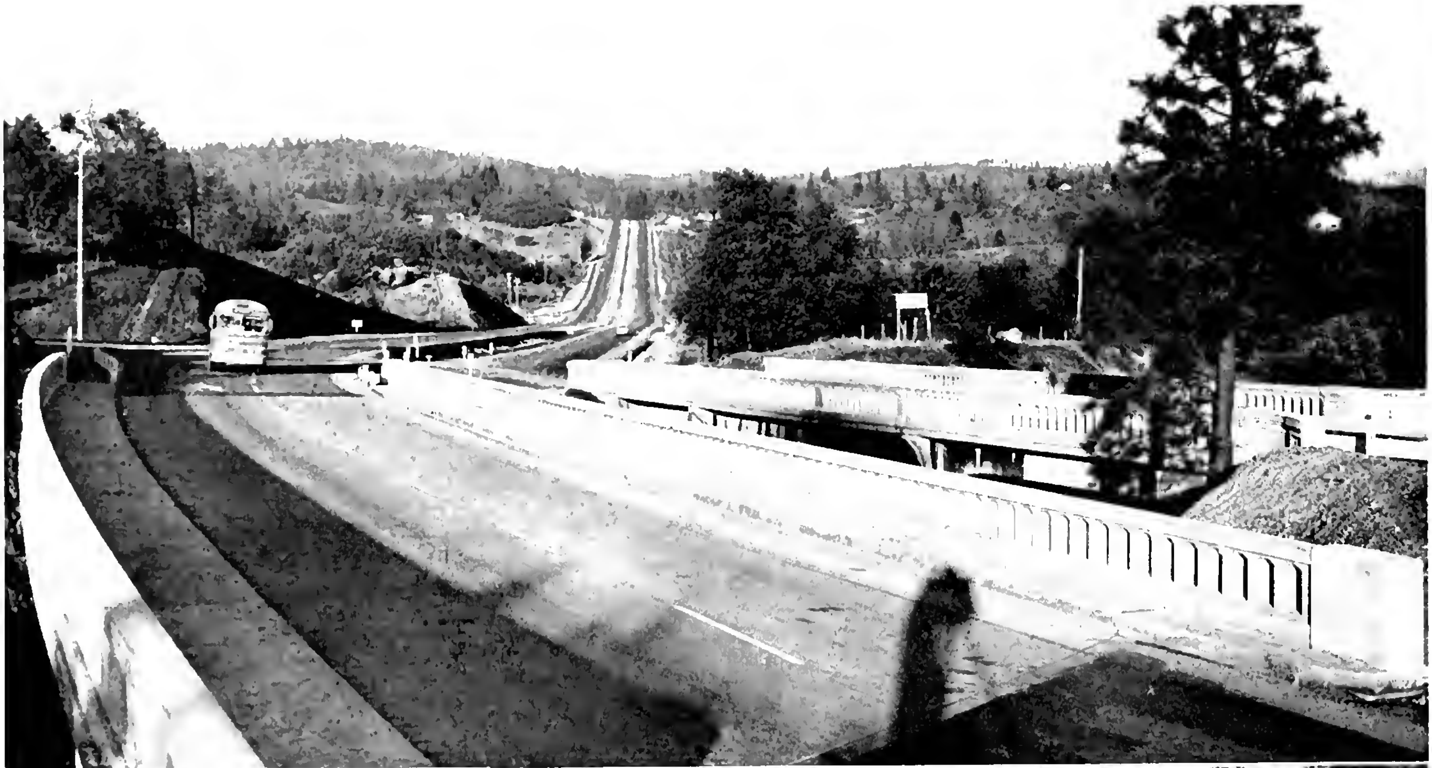
New San Leandro Bay Bridge

The new San Leandro Bay Bridge will be a four-lane divided, single-leaf bascule, of modern design and pleasing appearance. In anticipation of the ultimate development of the Oakland harbor, provisions are being made for the future addition of second leaf to provide a 200-foot width of channel for vessels entering San Leandro Bay. However, for the immediate future, the 92-foot-wide channel provided by the single leaf will be adequate for the small boats which presently use the opening. The vertical clearance for water craft will be unlimited. The roadway width on the bridge will be 58 feet with a six-foot division strip.

It is estimated that the new bridge, together with the approaches, will cost in the neighborhood of $1,500,000. It is expected that construction of the new bridge will begin late in the spring of 1951. Further information regarding the new bridge will be published in a later issue of this magazine.

Map of Alameda, showing original location and present location of San Leandro Bay Bridge





A RELIEF

Motorists traveling U. S. 40 between Auburn and Applegate in Placer County find it a relief to encounter only 14 curves on the 6.1 miles-section of the new freeway between these points instead of the 56 curves which existed on the old highway.

The completed project now in use joins the freeway one mile east of Auburn and extends easterly to one mile west of Applegate. There are two overhead crossings of the Southern Pacific Railroad at Bowman.

The choice of location of this realignment made possible the use of light grades and the maximum of 6 percent has been reached on only two sections, each of which is less than 2,000 feet in length. On the old highway grades were as high as 7 percent.

Pavements are 24 feet in width and shoulders eight feet and five feet wide in each roadbed with a division strip 36 feet wide.

Grading and structures for the new highway cost approximately $1,470,000 and the paving cost $345,500.

UPPER Bowman Overhead structure near beginning of project. New structure on left, old structure on right, which is now used for eastbound traffic only. LOWER Looking east on new four-lane divided alignment near east end of project.

HIGHWAY BIDS AND AWARDS

January, 1951

ALAMEDA, CONTRA COSTA COUNTY—In the Cities of Berkeley and Richmond, at the intersections of Eastshore Highway with University Avenue, Central Avenue and Carlson Boulevard, a full traffic actuated signal system and highway lighting system to be furnished and installed at one intersection, modification of traffic signal systems at two intersections and channelization to be constructed at three intersections. District IV, Route 69. J. R. Armstrong, El Cerrito, $30,292; J. Henry Harris, Berkeley, $34,066. Contract awarded to Lee J. Immel, San Pablo, $30,052.

FRESNO COUNTY—At the intersection of U. S. 99 and Church Avenue at the south city limits of Fresno, a traffic signal system. District VI, Route 4. Clinton Electric Corp., Burbank, $13,746; L. H. Leonardi Electric Construction Co., San Rafael, $14,-825; Robinson Electric, Fresno, $15,000. Contract awarded to Westates Electrical Construction Co., Los Angeles, $12,546.

LOS ANGELES COUNTY—In the City of Burbank, on Front Street and Providencia Avenue, from 200 feet westerly of Olive Avenue to San Fernando Boulevard, about 0.6 mile, paving portions with asphalt concrete over untreated rock base and resurfacing portions wihh plant-mixed surfacing over existing pavement. District VII, Route 4. Boddum and Peterson, Long Beach, $58,850; Peter Kiewit Sons Co., Arcadia, $59,867; M. S. Mecham and Sons, South Gate, $61,345; Schroeder and Co., Sun Valley, $62,802; J. E. Haddock, Ltd., Pasadena, $63,041; Nappe Construction Co., Inc., Burbank, $63,981; Griffith Co., Los Angeles, $67,413. Contract awarded to Jesse S. Smith, Glendale, $57,920.

LOS ANGELES COUNTY—In the City of Los Angeles, between Virgil Avenue and Beaudry Avenue, about 2.3 miles of roadside areas to be prepared and planted. District VII, Route 2. Stephen L. Vistica, San Mateo, $42,802; James E. Boothe, Lynwood, $47,786; Henry C. Soto Corp., Los Angeles, $49,856; Huetting, Schromm and Bennett, Palo Alto, $59,215. Contract awarded to Jannoch Nurseries, Altadena, $40,876.01.

LOS ANGELES COUNTY—In the City of Los Angeles, on Pacific Coast Highway at Sunset Boulevard and Chautaugua Boulevard, portions about 0.7 mile, the existing pavement to be widened by constructing plant-mixed surfacing on untreated rock base and widening the existing reinforced concrete bridge across Santa Monica Storm Drain extension. District VII, Route 60. J. E. Haddock, Ltd., Pasadena, $66,913; George Savala, Studio City, $67,816; Boddum and Peterson, Long Beach, $67,956; McClain Construction Co., Inc., Hawthorne, $68,-483; Griffith Co., Los Angeles, $72,014. Contract awarded to Jesse S. Smith, Glendale, $66,028.50.

LOS ANGELES COUNTY—On Hollywood-Santa Ana Freeway in the City of Los Angeles between Grand Avenue and Los Angeles Street, about 0.5 mile to be graded and paved with Portland cement concrete and asphalt concrete and reinforced concrete outer highway overcrossing to be constructed. District VII, Route 2. J. E. Haddock, Ltd., Pasadena, $923,972; Guy F. Atkinson Co., Long Beach, $956,561; Griffith Company, Los Angeles, $984,511; Clyde W. Wood and Sons, Inc., North Hollywood, $1,508,128. Contract awarded to Webb and White, Los Angeles, $902,792.80.

LOS ANGELES COUNTY—In the City of South Gate, on Firestone Boulevard at Rayo Avenue, full traffic actuated signal system with highway lighting to be furnished and installed and channelization to be constructed. District VII, Route 174. Vido Kovacevich Co., South Gate, $20,279; Electric and Machinery Service, Inc., South Gate, $21,131; Boddum and Peterson, Long Beach, $24,772. Contract awarded to Fischbach and Moore of California, Los Angeles, $19,883.50

LOS ANGELES COUNTY—In and adjacent to the City of Pasadena at the intersection of Rosemead Boulevard with Foothill Boulevard, traffic signal system and highway lighting to be furnished and installed. District VII, Routes 9, 168. Westates Electrical Construction Co., Los Angeles, $11,572; Electric and Machinery Service, Inc., South Gate, $12,149; C. D. Draucker, Inc., Los Angeles, $12,794. Contract awarded to Fischbach and Moore of California, Inc., Los Angeles, $10,725.

LOS ANGELES COUNTY—On Hollywood Freeway at Holly Drive, in the City of Los Angeles, a reinforced concrete bridge to be constructed. District VII, Route 2. Webb and White, Los Angeles, $288,163; J. E. Haddock, Ltd., Pasadena, $292,238; Lars Oberg and R. R. Bishop, Los Angeles, $323,076; Bongiovanni Construction Co., Los Angeles, $323,-345; Charles MacClosky Co., San Francisco, $323,-808; Fredericksen and Kasler, Sacramento, $325,980. Contract awarded to George W. Peterson and Jack W. Baker, Los Angeles, $286,090.

LOS ANGELES COUNTY—In the City of Inglewood at the intersection of La Brea Avenue with Kelso Street and with Hardy Street and Manchester Boulevard with West Boulevard, 11th Avenue, Crenshaw Boulevard, Seventh Avenue and with Fifth Avenue, furnish and install fixed-time traffic signal systems at five intersections and furnish and install modifications to fixed-time traffic signal systems at two intersections. District VII, Routes 164, 174. Fischbach & Moore of California, Inc., Los Angeles, $13,543; Westates Electrical Construction Co., Los Angeles, $16,089. Contract awarded to Electric & Machinery Service, Inc., South Gate, $13,237.

MARIN COUNTY—Between Ignacio and Forbes Overhead, a length of about 5.5 miles, to be graded and surfaced with plant-mixed surfacing on cement-treated base; construct two reinforced concrete bridges and repair one bridge and install a traffic signal system and highway lighting systems. District IV, Route 1, Section A. A. G. Raisch Co., San Rafael, $1,047,926; Harms Brothers and Charles MacClosky Co., Sacramento, $1,111,786; Fredrickson and Watson Construction Co., Oakland, $1,154,773; Eaton and Smith and Clements and Co., San Francisco, $1,192,771; Charles L. Harney, Inc., San Francisco, $1,259,109. Contract awarded to Granite Construction Co., Watsonville, $1,032,455.

ORANGE COUNTY—Between Sea Scout Base and south city limits of Newport Beach, about 3.7 miles to be widened and surfaced with plant-mixed surfacing on untreated rock base and the existing pavement. District VII, Route 60, Section B. Sully-Miller Construction Co., Long Beach, $160,921; John J. Swigart Co., Torrance, $167,422; Peter Kiewit Sons Co., Arcadia, $174,340; M. S. Mecham and Sons, South Gate, $174,990; Basich Brothers Construction Co., R. L. Basich-N. L. Basich, San Gabriel, $180,069; Baker and Pollock, Ventura, $181,377; Roland T. Reynolds, Anaheim, $184,340; Griffith Co., Los Angeles, $193,255. Contract awarded to Cox Brothers Construction Co., Stanton, $155,960.

SACRAMENTO COUNTY—In the City of Sacramento on N Street between 10th Street and 13th Street, curbs and gutters to be constructed. District III, Route 6. A. Teichert & Son, Inc., Sacramento, $6,675; Brighton Sand & Gravel So., Sacramento, $10,065; McGillivray Construction Co., Sacramento, $10,577. Contract awarded to J. R. Reeves, Sacramento, $6,075.50.

SAN BERNARDINO COUNTY—On Foothill Boulevard at San Bernardino Road, about 0.3 mile, constructing a graded roadbed for a channelized intersection and constructing plant-mixed surfacing on imported borrow and the existing pavement, apply seal coats and install highway lighting system. District VIII, Route 9, Section A. E. L. Yeager Co., Riverside, $30,013; George Herz and Co., San Bernardino, $32,050; R. A. Erwin, Colton, $33,932. Contract awarded to Boddum and Peterson, Long Beach, $21,997.50.

SAN DIEGO COUNTY—On Route 12 at intersections with East La Mesa Boulevard, Fuerte Drive, and Murray Avenue, a full traffic actuated signal system and highway lighting to be furnished and installed at one intersection and highway lighting to be furnished and installed and channelization to be constructed at two intersections. District XI, Route 12, Section B. Griffith Co., Los Angeles, $47,-082; Cox Brothers Construction Co., Stanton, $47,-305; V. R. Dennis Construction Co., San Diego, $48,288. Contract awarded to R. E. Hazard Contracting Co., Inc., San Diego, $43,934.70.

SAN DIEGO COUNTY—In the City of San Diego, at the intersection of El Cajon Boulevard with 56th Street and with 59th Street and Market Street with Kettner Boulevard, full traffic actuated signal system with highway lighting at one intersection and semitraffic actuated signal systems with highway lighting at two intersections to be furnished and installed. District XI, Routes 12, 200. Ets-Hokin and Galvan, San Diego, $22,790. Contract awarded to California Electric Works, San Diego, $21,850.

SAN MATEO COUNTY—In the City of Menlo Park, on El Camino Real, furnish and install semi-traffic actuated signal systems at the Valparaiso Avenue and Oak Grove Avenue intersection, modify the existing traffic actuated signal systems at the Santa Cruz Avenue and Ravenswood Avenue intersection and interconnect the four intersections. District IV, Route 2, Section MP. R. Flatland, San Mateo, $26,568; R. Goold and Son, Stockton, $27,-076; Central Electric Co., Inc., San Francisco, $27,-951. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $23,920.25.

SANTA BARBARA COUNTY—Between San Julian Ranch and 1.8 miles north of Ytias Creek, about 3.2 miles to be graded and surfaced with plant-mixed surfacing on cement-treated imported base material. District V, Route 56, Section A, B. Basich Brothers Construction Co., R. L. Basich-N. L. Basich, Garvey, $249,112; Clyde W. Wood and Sons, Inc., North Hollywood, $253,992; Granite Construction Co., Watsonville, $258,957; Dimmitt and Taylor, Monrovia, $262,322; Madonna Construction Co., San Luis Obispo, $274,667. Contract awarded to Valley Paving and Construction Co., Pismo Beach, $242,144.50.

SANTA CLARA COUNTY—At Mathilda Avenue in Sunnyvale, about 0.1 mile to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Route 114. Leo F. Piazza Paving Co., San Jose, $22,312; A. J. Raisch Paving Co., San Jose, $22,616. Contract awarded to Edward Keeble, San Jose, $21,167.

TULARE COUNTY—Between 1 mile north of Goshen and Traver, about 6.3 miles to be graded and paved with Portland cement concrete on cement treated subbase and five reinforced concrete bridges to be constructed. District VI, Route 4, Section E. United Concrete Pipe Corporation, Baldwin Park, $678,496; Guy F. Atkinson Co., South San Francisco, $684,484; Peter Kiewit Sons' Co., Arcadia, $705,817; M. J. B. Construction Co., Stockton, $738,661; Ball and Simpson, Berkeley, $751,183; Cox Brothers Construction Co. and J. E. Haddock, Ltd., Pasadena, $787,867. Contract awarded to Griffith Co., Los Angeles, $660,552.

F. A. S. County Routes

KERN COUNTY—On Weed Patch-Wheeler Ridge Road, between David Road and Wheeler Ridge, about 6.9 miles, plant-mixed surfacing to be placed over existing surfacing on portions of the project and over cement-treated base on the remainder of project. District VI, Route 574. Griffith Co., Los Angeles, $90,831; Hensler Construction Corp., Sun Valley, $92,972; G. W. Ellis Construction Co., North Hollywood, $97,430; James L. Miller and Sons, Los Angeles, $102,322; Ball and Simpson, Berkeley, $110,430; A. Teichert and Son, Inc., Sacramento, $112,645; Dieco, Inc., Bakersfield, $112,737. Contract awarded to Oilfields Trucking Co., and Phoenix Construction Co., Inc., Bakersfield, $87,447.10.

February, 1951

LASSEN COUNTY—Between Slate Creek and Grasshopper Valley Ranch, about 1.8 miles to be graded and surfaced with road mixed surfacing on gravel base. District II, Route 988, Section J. H. D. No. 14. Baker Trucking Co., Hamilton City, $41,567; M. W. Brown, Redding, $42,965; H. Earl Parker, Inc., Marysville, $52,289; O'Connor Brothers, Red Bluff, $61,457; J. Henry Harris, Berkeley, $68,407. Contract awarded to W. H. O'Hair Co., Colusa, $39,602.80.

LOS ANGELES COUNTY—Between north city limits of Los Angeles, near Tunnel Station bridge, and Pico Canyon Road, about 5.1 miles to be graded and surfaced with Portland cement concrete pavement and plant mixed surfacing. District VII, Route 4, Section I. Peter Kiewit Sons' Co., Arcadia, $1,067,364; Cox Brothers Construction Company and J. E. Haddock, Ltd., Pasadena, $1,094,038; United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,148,644; Clyde W. Wood and Sons, Inc., North Hollywood, $1,150,154; A. Teichert and Sons, Inc., Sacramento, $1,168,182; Griffith Co., Los Angeles, $1,190,352; Ball and Simpson, Berkeley, $1,219,123; Basich Brothers Construction Co., R. L. Basich N. L. Basich, Garvey, $1,341,349; Bressi and Bevanda Constructors, Inc., North Hollywood, $1,356,706. Contract awarded to Claude Fisher Co., Ltd., Los Angeles, $1,025,284.

LOS ANGELES COUNTY—On Ramona Freeway between 0.2 mile east of Helen Drive and Hellman Ave., about 1.5 miles to be graded and paved with Portland cement concrete on cement treated surface and with plant-mixed surfacing on imported base material; and four bridges to be constructed; to provide a six-lane divided highway with frontage roads. District VII, Route 26, Section D, L. A., Alh. United Concrete Pipe Corp., and Ralph A. Bell, Baldwin Park, $1,879,725; Griffith Co., Los Angeles, $1,903,571; Guy F. Atkinson Co., Long Beach, $1,923,206. Contract awarded to J. E. Haddock, Ltd., Pasadena, $1,769,134.60.

LOS ANGELES COUNTY—On state highway in the City of Burbank, between Burbank Boulevard and Magnolia Boulevard, constructing chain-link fences. District VII, Route 4, Section Brb. Pacific Fence Co., Los Angeles, $4,048; Los Angeles Fencing Co., Inc., Los Angeles, $4,228; Crown Fence and Supply Co., Ltd., Pasadena, $4,233; Henry C. Soto Corp., Los Angeles, $4,295; Alcorn Fence Co., Los Angeles, $4,635; Cyclone Fence Div., Glendale, $4,909. Contract awarded to American Chain Link Machine Co., Los Angeles, $3,795.

LOS ANGELES COUNTY—On Hollywood Freeway, at Hollywood Boulevard in the City of Los Angeles, a reinforced concrete box girder bridge for an overcrossing to be constructed. District VIII, Route 2. J. E. Haddock, Ltd., Pasadena, $327,072; Charles MacClosky Co., San Francisco, $331,643; Bongiovanni Construction Co., Hollywood, $331,743; Webb and White, Los Angeles, $344,028; George W. Peterson and Jack W. Baker, Los Angeles, $377,368. Contract awarded to Fredericksen and Kalser, Sacramento, $320,942.58.

MARIN COUNTY—Near the southerly end of the San Rafael Viaduct, constructing pump house and pump sump and installing drainage facilities. District IV, Route 1. Contract awarded to S and Q Construction Co., San Francisco, $24,500.

ORANGE COUNTY—Between Peralta School and Riverside County Line, about 6.1 miles to be graded and surfaced with plant mixed surfacing on cement treated base. District VII, Route 43, Section B. Peter Kiewit Sons Co., Arcadia, $932,523; Griffith Co., Los Angeles, $938,979; Cox Brothers Construction Co., J. E. Haddock, Ltd., Pasadena, $1,033,338, United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,074,033; Hess Construction Co., Inc., Long Beach, $1,082,016; Fredericksen and Kasler, Sacramento, $1,109,616; E. L. Yeager Co., Riverside, $1,155,849; Arthur H. Famularo and Roland T. Reynolds, Anaheim, $1,234,103; Basich Brothers Construction Co., R. L. Basich N. L. Basich, Garvey, $1,319,149. Contract awarded to A. Teichert and Son, Inc., Sacramento, $917,600.50.

PLUMAS COUNTY—Near Blairsden, mineral aggregate to be furnished and stockpiled. District II, Route 83, Section A. M. W. Brown, Redding, $22,500; Allen and Reddy, Red Bluff, $24,800; Harms Brothers, Sacramento, $28,000; Boyce Construction Co., Tahoe Vista, $30,000. Contract awarded to Rice Brothers, Inc., Marysville, $14,800.

SAN BENITO AND SANTA CLARA COUNTIES—At Pajaro River about 5.3 miles southeast of Gilroy, about 0.4 mile, approaches to be graded and surfaced with plant-mixed surfacing on cement treated imported base material and a reinforced concrete bridge to be constructed. District V, Route 119, Section F. A. Thomas Construction Co., Fresno, $102,353; Dan Caputo, San Jose, $110,703; Eaton and Smith, San Francisco, $114,492. Contract awarded to Fredrickson and Watson Construction Co., Oakland, $98,782.95.

SAN BERNARDINO COUNTY—Installation of drainage improvements at the intersection of I Street and Highland Avenue. District VIII, Route 190 SB. Lloyd R. Johnson, Rialto, $11,965. Contract awarded to George Herz and Co., San Bernardino, $10,398.50.

SAN BERNARDINO COUNTY—In the City of San Bernardino, on Highland Avenue at Mt. Vernon Avenue, Cajon Boulevard and at "I" Street, traffic signal systems and highway lighting to be furnished and installed and traffic island, curbs and pavement widening to be constructed. District VIII, Route 31, 190. Paul R. Gardner, Ontario, $25,219; Westates Electrical Construction Co., Los Angeles, $25,295. Contract awarded to Fischbach and Moore of California, Inc., Los Angeles, $24,887.

SAN DIEGO COUNTY—Across San Diego River in the City of San Diego, a bridge extension to be constructed and about 0.5 mile detour and bridge approach to be graded and surfaced. District XI, Route 2. Bent Construction Co., Los Angeles, $344,126; M. H. Golden Construction Co., San Diego, $380,773; Charles MacClosky Co., C. G. Willis and Sons, Inc., and R. E. Hazard Contracting Co., San Francisco, $392,714; J. E. Haddock, Ltd., Pasadena, $396,892. Contract awarded to Guy F. Atkinson Co., Long Beach, $341,163.

SANTA CRUZ COUNTY—Construction of a 500-foot line change approximately one-half mile north of Boulder Creek. District IV, Route 116. Leo Cardwell Construction Co., Santa Cruz, $14,062; Carey Brothers Construction, San Anselmo, $14,543; J. Henry Harris, Berkeley, $22,560; Elmer J. Warner, Stockton, $25,751; Edward Keeble, San Jose, $27,028; Eugene G. Alves, Pittsburg, $31,666. Contract awarded to Granite Construction Co., Watsonville, $12,916.

SOLANO COUNTY—At the Nut Tree and at Alamo Creek, about 0.7 mile frontage road to be graded and surfaced with plant-mixed surfacing on untreated rock base. District X, Route 7, Section C, D. Fredericksen Brothers, Emeryville, $37,537; J. Henry Harris, Berkeley, $43,402. Contract awarded to Harms Brothers, Sacramento, $30,324.

VENTURA COUNTY—At the intersection of Ventura Avenue with Main Street, Park Row Avenue, Center Street and Ramona Street in the City of Ventura. Traffic signal systems to be furnished and installed and modified. District VII, Route 138. Fischbach and Moore of California, Inc., Los Angeles, $13,356; Electric and Machinery Service, Inc., South Gate, $13,529; Westates Electrical Construction Co., Los Angeles, $14,175. Contract awarded to Clinton Electric Corp., Burbank, $12,431.

F. A. S. County Routes

RIVERSIDE COUNTY—Across Coachella Valley Storm Drain, near Thermal, a reinforced concrete slab bridge on concrete pile bents to be constructed. District XI, Route 734. E. G. Perham, Los Angeles, $69,879; Tumblin Co., Bakersfield, $70,708; E. L. Yeager Co., Riverside, $73,026; Anderson Co., Visalia, $75,854; C. B. Tuttle Co., Long Beach, $76,496; Griffith Co., Los Angeles, $77,935; Fredericksen and Kasler, Sacramento, $80,607; F. H. Thomas Co., Las Vegas, $80,925; Penn Construction Co., Baldwin Park, $81,785; Norman I. Fadel, North Hollywood, $93,606. Contract awarded to F. Fredenburg, Temple City, $69,425.

March, 1951

LOS ANGELES COUNTY—On Santa Ana Freeway, between 0.2 mile southeast of Washington Boulevard and Todd Avenue, about 1.5 miles to be graded and portions to be surfaced with Portland cement concrete on cement treated subgrade; interchange roadways, acceleration and deceleration lanes and outer highways to be surfaced with plant mixed surfacing on untreated rock base; two grade separation structures and a pedestrian overcross structure to be constructed to provide a freeway with a six-lane divided roadbed. District VII, Route 166, Section A. Griffith Co., Los Angeles, $1,519,806; Bongiovanni Construction Co., Hollywood, $1,543,048; Guy F. Atkinson Co., Long Beach, $1,563,572; J. E. Haddock, Ltd., Pasadena, $1,620,787; Contract awarded to United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, $1,396,954.30.

LOS ANGELES COUNTY—Over Harbor Freeway at Wilshire Boulevard, in the city of Los Angeles, a reinforced concrete box girder bridge to be constructed and road connections to be graded and paved. District VII, Route 165. Winston Brothers Co., Monrovia, $378,046; Charles MacClosky Co., San Francisco, $389,311; George W. Peterson and Jack W. Baker, Los Angeles, $399,878; J. E. Haddock, Ltd., Pasadena, $439,049; Bongiovanni Construction Co., Los Angeles, $447,250; Contract awarded to Webb and White, Los Angeles, $361,144.00.

LOS ANGELES COUNTY—On Colorado Freeway in the city of Pasadena, between San Rafael Avenue and Orange Grove Avenue, three bridges and approaches and alterations for an existing bridge to be constructed. District VII, Route 161, United Concrete Pipe Corp., Ralph A. Bell, B. J. Ukropina, T. P. Palich and Steve Kral, Baldwin Park, $3,561,831; Winston Bros. Company, Monrovia, $3,785,536; Peter Kiewit Sons Co., Arcadia, $3,853,677; Rhoades-Shofner Construction Co., Inc., and Grafe-Callahan Construction Co., Los Angeles, $4,299,992; Guy F. Atkinson Co., Long Beach, $3,389,650.00.

LOS ANGELES COUNTY—On Hollywood Freeway, at Cahuenga Boulevard, in the city of Los Angeles, a reinforced concrete box girder bridge for an undercrossing to be constructed. District VII, Route 2. Lars Oberg, Los Angeles, $278,075; Bongiovanni Const. Co., Hollywood, $291,736; Charles MacClosky Co., San Francisco, $294,306; J. E. Haddock, Ltd., Pasadena, $298,663; George W. Peterson and Jack W. Baker, Los Angeles, $310,651; Griffith Co., Los Angeles, $350,808; Contract awarded to Oberg Brothers Const. Co., Inglewood, $277,204.

LOS ANGELES, KERN, VENTURA COUNTIES—On Route 4 between Route 59 and Fort Tejon and Newhall Pico Road; and on Route 2 between Triunfo Road and ½ mile west of Moorpark Road, highway lighting system to be furnished and installed. District VII, Route 4, 2. Section J, D, A, F, A. Westates Electrical Construction Co., Los Angeles, $27,182; Fischbach and Moore Inc., Los Angeles, $27,666; Contract awarded to Electric and Machinery Service Inc., South Gate, $26,581.

MERCED AND STANISLAUS COUNTIES—Between Merced River Bridge and Turlock Overhead about 5.6 miles to be graded and paved with Portland cement concrete on cement treated subgrade. District X, Route 4, Section D, A. Guy F. Atkinson Co., South San Francisco, $693,448; M. J. B. Construction Co., Stockton, $724,262; Ball and Simpson, Berkeley, $728,343; Harms Brothers, Sacramento, $737,034; Fredrickson and Watson Construction Co., Oakland, $898,979; Contract awarded to United Concrete Pipe Corp., Baldwin Park, $617,724.30.

SACRAMENTO COUNTY—Across American River at H Street near easterly city limits of Sacramento, the existing bridge to be widened with timber, reinforced concrete and structural steel construction. District III, Route 98, Section A. H. W. Ruby, Sacramento, $136,988; Dan Caputo, San Jose, $138,750; George Pollock Co., Sacramento, $149,489; Chittenden and Chittenden and B. S. McElderry, Auburn, $159,635; Contract awarded to Lord and Bishop, Sacramento, $121,746.50.

SANTA BARBARA COUNTY—Between Gaviota Gorge and 0.5 mile north of Las Cruces, about 2 miles to be graded and surfaced with plant mixed surfacing on cement treated base. Roland T. Reynolds and A. H. Famularo, Anaheim, $667,803; Cox Brothers Construction Co., Stanton, $670,300; Ball

and Simpson, Berkeley, $733,266; Contract awarded to Granite Construction Co., Watsonville, $630,699.00.

SAN DIEGO COUNTY—Between Elm Avenue in Palm City and "G" Street in Chula Vista, about 3.8 miles to be graded and surfaced with plant mixed surfacing on cement treated base and reinforced concrete bridges to be constructed. District XI, Route 2, Section G. Charles MacClosky Co., R. E. Hazard Contracting Co., and C. G. Willis and Sons, San Francisco, $1,378,898; Basich Brothers Construction Co., N. L. and R. L. Basich, Garvey, $1,392,840; Fredericksen and Kasler, Sacramento, $1,499,685; Cox Brothers Construction Co., Stanton, $1,503,147; Contract awarded to Griffith Co., Los Angeles, $1,221,641.90.

SAN DIEGO COUNTY—In the City of Oceanside, between ¼ mile south of Mission Avenue and San Luis Rey River, about 1 mile to be graded and paved with Portland cement concrete pavement on cement treated subgrade to provide a 4 lane divided highway. Frontage roads are to be graded and surfaced with plant-mixed surfacing on selected material, ramps and connecting city streets are to be graded and surfaced with plant-mixed surfacing on cement treated base and 3 reinforced concrete box girder grade separation structures are to be constructed. District XI, Route 2. Griffith Co., Los Angeles, $968,066; Guy F. Atkinson Co., Long Beach, $1,032,000; Basich Brothers Construction Co., R. L. Basich and N. L. Basich, Garvey, $1,042,799; Contract awarded to Cox Brothers Construction Co., Stanton, $967,355.35.

SAN FRANCISCO COUNTY—On Harbor Pier No. 24; repairing, revising, and installing a portion of an automatic sprinkler system. District IV, Route 68. George M. Robinson and Co., Oakland, $1,435; Viking Automatic Sprinkler Co., San Francisco, $1,470; Contract awarded to Grinnell Co. of the Pacific, San Francisco, $1,300.00.

STANISLAUS COUNTY—Between 10.5 and 5.0 miles west of Modesto, about 3.5 miles to be surfaced with plant-mixed surfacing on untreated rock base. Beerman and Jones, Sonora, $129,920; Louis Biasotti and Son, Stockton, $134,954; Thomas Construction Co., Fresno, $143,581; United Concrete Pipe Corp., Baldwin Park, $144,950; M. J. B. Construction Co., Stockton, $161,089; Frank B. Marks, Jr., Newman, $171,430; Contract awarded to M. J. Ruddy and Son, Modesto, $120,890.

YUBA COUNTY—At the District III Office for constructing parking sheds and chain link fence. District III. R. Taylor Willis, Napa, $9,200; Commercial Construction Co., Marysville, $9,220; McDaniel Construction Co., Marysville, $9,220; Contract awarded to Robert Taylor, Oroville, $9,163.55.

F. A. S. County Routes

FRESNO COUNTY—On Manning Avenue, between Zediker Avenue and Kings River Bridge, about 3 miles to be graded and surfaced with plant-mixed surfacing on cement treated base. District VI, Route 817. Volpa Brothers, Fresno, $99,750; Gene Richards, Fresno, $103,490; Oilfields Trucking Co., and Phoenix Construction Co., Inc., Bakersfield, $104,089; Roland T. Reynolds and Thomas Construction Co., Fresno, $107,623; G. W. Ellis Construction Co., North Hollywood, $126,084; Contract awarded to Baun Construction Co., Fresno, $93,326.00.

LOS ANGELES COUNTY—Across San Gabriel River, on Beverly Boulevard, a combination reinforced concrete and structural steel bridge to be constructed. District VII, Route 845. George W. Peterson and Jack W. Baker, Los Angeles, $274,970; John Strona, Pomona, $295,126; J. E. Haddock, Ltd., Pasadena, $335,337; Macco Corporation, Paramount, $344,390; Contract awarded to Charles MacClosky Co., San Francisco, $273,820.00.

SAN BERNARDINO, RIVERSIDE COUNTIES—On Riverside Drive between Los Angeles County Line and State Route 19, about 11.7 miles to be graded and surfaced with plant-mixed surfacing and the existing reinforced concrete and structural steel bridge across Chino Creek to be widened. District VIII, Route 693. M. S. Mecham and Sons, South Gate, $408,875; Maticb Brothers and A. S. Hubbs, Colton, $412,058; R. A. Erwin, Colton, $416,436; Hensler Construction Corp., Sun Valley, $435,295; Basich Brothers Construction Co., R. L. Basich and N. L. Basich, Garvey, $467,164; Griffith Co., Los Angeles, $476,400; Cox Brothers Construction Co., Stanton, $477,544; Peter Kiewit Sons' Co., Arcadia, $493,472; Hess Construction Co. Inc., Long Beach, $497,528; Contract awarded to E. L. Yeager Co., Riverside, $390,745.40.

SAN LUIS OBISPO COUNTY—On Calf Canyon Huer Huero Road, between Creston Highland Road and 0.85 mile east of State Route 137, about 4.3 miles to be graded and a reinforced concrete bridge to be constructed. District V, Route 676. Edward Keeble, San Jose, $151,524; John F. Blakemore, El Monte, $153,195; Chittenden and Chittenden, Auburn, $178,268; Kirst and Sons, Altadena, $187,857; Fredericksen and Kasler, Sacramento, $196,447; Roland T. Reynolds and Thomas Construction Co., Fresno, $196,762; M. J. B. Construction Co., Stockton, $196,856; E. S. and N. S. Johnson and E. G. Young, Fullerton, $198,413; M. S. Mecham and Sons, South Gate, $201,615; Rexroth and Rexroth, Bakersfield, $212,126; Hess Construction Co., Inc., Long Beach, $217,074; Anderson Co., Visalia, $221,175; Granite Construction Co., Watsonville, $227,850; Pacific Contracting Co., Newport Beach, $232,088; Contract awarded to Fred McKinley, Paramount, $130,920.50.

George C. Hanson Retires After 39 Years In State Service

GEORGE C. HANSON, Assistant Highway Engineer in the office of City and Cooperative Projects, Division of Highways, retired from state service on March 1, 1951, after 39 years continuous service.

Born in Silverton, Colorado, August 26, 1887, he was educated in the public schools of Colorado and Kansas and came to California with his parents in 1905. His first job in California was with the Sacramento Division of the Southern Pacific Maintenance of Way Department from 1907 to 1912, where he rose to the position of Chief Draftsman. On March 1, 1912, he went to work with the Division of Highways as Chief Draftsman in Division III. When Division III was divided into District III and District X in 1927, he was assigned to District X as Statistical Engineer and moved with the district to Stockton in September, 1933, where he remained until March, 1936, when he transferred to the office of City and Cooperative Projects in Headquarters at Sacramento.

Hanson's hobby is photography and he looks forward to spending many happy hours pursuing his favorite pastime.

California Highways

Continued from page 49 . . .

Future Military Operations

Modern mechanized warfare calls for the use of every type of civilian vehicle, plus others designed for specialized military requirements. Because of California's strategic location and the extensive operations conducted by the Army and Navy, it is probable that military traffic on the highways during the war was heavier than in any other state.

Although peacetime military use of the highways constitutes only a small percentage of the total traffic, it continues to be heavier than before the war, due to the large number of permanent installations maintained within the State. It is a primary function of any public road system to accommodate military traffic, and this must be considered in administering highway programs. Provision must be made, in particular, for unusually large and heavy vehicles.

In the event of an emergency, it must be expected that California's highway system will be called upon to assume heavy military burdens with little time for advance preparation.

California Highways in the Crisis Ahead

The result of these facts substantiates the previous statement that to all intents and purposes the California State Highway System is an integrated access road network.

During World War II restrictions imposed by the Federal Government drastically curtailed construction of vitally needed improvements on the State Highway System. These restrictions were so drastic that for all practical purposes they effectively stopped the construction of new or improved facilities on the State Highway System. Most of the work done by the Division of Highways during the war years was the minimum maintenance of existing highways and the construction of access roads and flight strips for the Federal Government.

These federal restrictions were imposed at a very unfortunate time. The highway modernization program was just beginning to overcome the effects

of the depression years that had caused a slowdown due to lack of revenue. In other words, when California was about to make some progress in correcting deficiencies that existed, the war restrictions stopped all modernization activities for four years.

Thus it should be pointed out that these two factors alone: (1) the State Highway System was considerably below acceptable standards in 1941, and (2) there were practically no modern improvements made in the four war years, were enough in themselves to create a compounding of highway needs that was enormous.

To these two factors was added the damage caused to the State Highway System by war-induced heavy trucking and the enormous increase in population caused by the war effort. All of these factors together added up to the deficiencies at the end of World War II. In 1945 and 1946 these deficiencies were compiled. The estimated cost of correcting the deficiencies that existed at that time was approximately $1,500,000,000, based on a 10-year period of construction, and based on construction costs that were expected to decline after the war. At that time many experts believed that considerable portion of the population growth in California during the war was only temporary. This deficiency list was therefore based on rather conservative estimates of future population growth.

Highway Deficiencies

During the latter part of 1950 a reappraisal was made of the deficiencies of the State Highway System as of January 1, 1951. This report shows that the present estimated cost of bringing the State Highway System up to modern standards adequate for traffic is over $3,000,000,000, or twice the 1946 estimated cost. This doubling of the deficiencies has occurred during the period when the Division of Highways has had under way the greatest highway construction program in its history. In the five-year period from July 1, 1947, to June 30, 1952, 93 percent of the available construction funds, or over $420,000,000, were expended or budgeted for correction of deficiencies on the 1946 list.

This extremely critical situation may be stated in another way. In spite of the all-out effort that has been made in the postwar period to modernize the State Highway System with the funds available, the deficiencies have increased over previous estimates at a rate of $300,000,000 per year.

By far the greatest deficiencies that exist are those chargeable to inadequate traffic capacity, or lack of highway space on which to move traffic safely and efficiently.

In 1946, major routes of our rural State Highway System carried an average daily traffic of 1,700 vehicles. Today, on these same rural routes, the count is 3,000—nearly a 100 percent increase in less than five years. It is imperative that California complete at the earliest possible date the multilane facilities necessary to handle this traffic. Deficiencies in this category, as well as many of the structural deficiencies, are directly attributable to the unprecedented growth in population and vehicle registration in California.

Highway Work Must Not Slow Down

There are 14,000 miles in the State Highway System, of which 11,300 miles, or 81 percent, was deficient in some respect on January 1, 1951.

There is every reason to believe that the pattern of a large population increase in California induced by defense activities in World War II will be repeated. Undoubtedly nearly all of the defense plants will again be producing materials of war and most of the military establishments will be reactivated. In addition there will probably be many new defense industries and military establishments.

Thus the motivating forces behind the highway problem that exists today—too rapid expansion of population and vehicle registration—will continue as long as an all-out defense effort is being made.

A continual increase in deficiencies on the State Highway System can have only one end result: the gradual strangulation of transportation in California. This would have a chaotic effect on the defense effort in California, where every operation, both industrial and military, is more completely dependent upon highway transportation than in any other part of the United States.

The fact that highway improvements made to benefit the defense effort also are a benefit to the State's economy proves that the two interests are inseparable.

Any restriction by the Federal Government, in the name of national defense, that would in any way slow down the rate of improvement to the State Highway System would be a very costly mistake that would defeat its own purpose. The present rate of progress in correcting the critical deficiencies on the State Highway System is much too slow at the present by any conceivable standards of measurement. Further retardment of this rate of progress would be disastrous.

California's Highway System is essentially a great military and industrial access road system and should be considered in that light by the Federal Government when means of accelerating the defense effort are under consideration.

Suggestion to Merit Award Board Worth While

THE FIRST merit award made to a Department of Public Works employee, carrying both cash and merit award, was presented by Frank Durkee, Deputy Director of Public Works, on March 30, in San Diego.

The award winning development is a copy holder attachment which adapts the copy holder for use with the Remington Rand bookkeeping machine in the District XI office in San Diego.

When the new Remington Rand Model 685-D bookkeeping machine was received in District XI, it was found that the regulation copy holder could not be used satisfactorily, although it had worked with the old type machine. Mrs. Aurelia Rinderneck of the Bookkeeping Department, A. L. Anderson, Chief Clerk, and Ed Malloy, Mechanic Foreman at Shop 11, collaborated in the design and construction of an attachment for the copy holder so that it could be used with the new machine. It has been estimated that the device is saving the State approximately $620 per year in the Division of Highways alone. The board, therefore, recommended that in addition to the Certificates of Merit an award of $21 be made to each of the three.

Highway Costs

They Have Increased 10.6 Percent During the First Quarter of 1951

By RICHARD H. WILSON, Assistant State Highway Engineer; HENRY C. McCARTY, Office Engineer, and RICHARD R. NORTON, Assistant Office Engineer

The cost of state highway construction in California has increased 10.6 percent in the first quarter of this year and 34.6 percent during the past year.

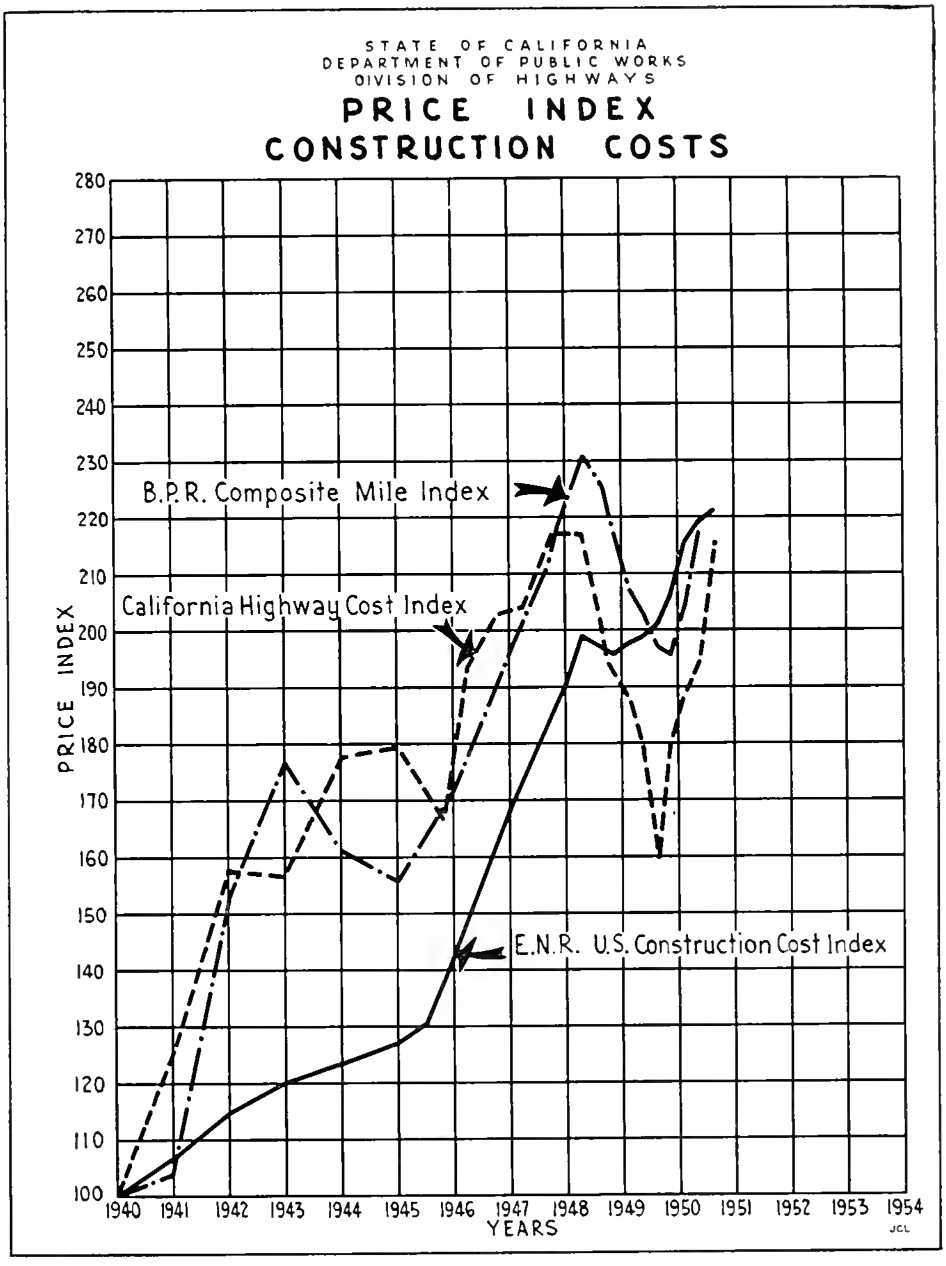
Highway costs are measured by the California Highway Construction Cost Index, with the year 1940 taken as a base of 100. This index climbed during World War II and the postwar period to a peak of 216.8 in the first half of 1948. After 1948 there was a decline to 160.0 in the first quarter of 1950. From this point on there has been a very rapid rise. he second quarter of 1950 was 12.5 percent above the first quarter, the third quarter was 5.1 percent above the second quarter, the fourth quarter fas 3.0 percent above the third quarter and the index reached 215.4 in the first quarter of 1951 which was 10.6 percent above the fourth quarter of 1950. There are no indications at the present time that this upward trend will not continue.

As high as these costs appear, they are well below the national average, as measured by the Bureau of Public Roads Composite Mile Index. The BPR index is recognized as the standard of measurement for nation-wide highway construction costs.

The BPR index reached a peak in the postwar period of 230.9 (1940 = 100) compared to the 216.8 peak reached by California index. The BPR index peak was 14.1 points or 6.5 percent higher than the California index peak.

After the first postwar peak in 1948, both indexes turned downward until 1950. The low point reached in the second quarter of 1950 by the BPR index of 195.5 was 35.5 points or 22.2 percent higher than the low of 160.0 reached by the California index.

In the fourth quarter of 1950 (the latest period for which BPR index figures are available) the BPR index of 217.5 was 22.7 points or 11.7 percent higher than the California index of 194.8 for the same period.



Following is a tabulation showing a comparison of the Bureau of Public Roads and California indexes in the postwar period:

Year	California Index (1940=100)	Bureau of Public Roads Index (1940=100)	Difference Points	Difference Percent
1946	179.7	171.6	—8.1	—4.5
1947	203.3	196.1	—7.2	—3.5
1948	216.6	220.9	+4.3	+2.0
1949	192.8	213.3	+20.5	+10.6
1950	181.0	203.4	+22.4	+12.4

These figures show a very significant trend in California highway construction costs as compared to nation-wide costs. California highway costs were higher than the national average in 1946 and 1947. In 1948 California costs were lower, and in 1949 and 1950 the difference increased in California's favor.

The Engineering News-Record Construction Cost Index, converted to 1940 = 100, is shown also on the accompanying chart to show its relationship to the California and BPR indexes. The ENR index is an index of labor and material prices only and is not a contract price index as are the California and BPR indexes. For this reason the ENR index does not show the rapid fluctuations that the contract price indexes have in the postwar period. However the long-term trend has been similar. In the first quarter of 1951 the ENR index was 221.2, compared to 215.4 for the California index.

The rapid fluctuations in highway construction costs that have taken place in the postwar period have created many serious problems in budgeting future construction programs. For instance, the projects now being placed under contract were budgeted one year ago. In that period highway costs have increased 34.6 percent. Obviously estimates based on prices a year ago are not valid today.

These changes in the price structure require constant revision of estimates and adjustment of projects to attempt to keep abreast of changing economic conditions. Unless and until more stable world conditions prevail it will probably be impossible to forecast changing costs accurately enough to prevent the necessity for these adjustments. The Korean War was certainly not foreseeable a year ago.

A constant study of economic trends to determine their effect on both sources of revenue and construction costs is made by the engineers of the Division of Highways to keep budget adjustments to a minimum.

FAST BRAKING

Braking the car to a sudden stop is as wasteful of engine power as a fast start. Let built-up momentum carry the car forward to a stop without needless wear on brakes and tires.

VETERAN STATE EMPLOYEES WILL BE RECOGNIZED

Presentations of certificates to state employees in recognition of 25 years of service, as authorized by the 1949 Legislature, began in March. Deputy Director of Public Works Frank B. Durkee was chairman of the committee of the Deputy Directors' Conference to which was delegated the work of designing a suitable memento and drafting the details for official presentation of the certificates.

The State Printing Office printed 2,500 certificates which now are available to all state departments and agencies. They are embellished on the borders with sketches of the Capitol dome, golden poppies, the official California flower, the Bear flag, quail, the California game bird, a miner's pan, pick and shovel and redwood trees, for which California is famous, all in color. The art work was done by J. J. Ralph of the Division of Highways.

Through the efforts of Harold P. Norton, Special Representative of the Department of Public Works, and Tom Dennis, Maintenance Superintendent of the Division of Highways, retired, a bill was enacted by the Legislature in 1949 authorizing the printing and awarding of the certificates which will be given to each state employee who has served for 25 years or more.

Each certificate will be signed by Governor Earl Warren and will bear the signature of the Secretary of State and the Great Seal of California. Future Governors and Secretaries of State will sign the awards as the years go by.

Durkee has recommended to Daniel H. Blood, President of the Deputy Directors' Conference, that the existing law be amended so as to provide certificates to retired state employees who had 25 or more years of service at the time of their retirement. The following served with Durkee on the Deputy Directors' Conference Committee: George E. Hogan, Department of Education, and W. C. Jacobsen, Department of Agriculture.

Certificates may be obtained by State agencies from A. Earl Washburn, Deputy Director of Finance.

Mission Accomplished

While William H. Hamblin, now on military leave with the Navy as supply officer on the *U.S.S. Menard* in Pacific waters, was assistant to Director of Public Works C. H. Purcell he learned much about the close cooperation that exists between the Division of Highways, California Highway Patrol and Department of Motor Vehicles. This kowledge came in handy recently as he relates in the following note:

"A few days before we were to leave the United States, we found that one of our men, George Frazee, seaman, of Santa Ana was on leave and could not be reached. We learned that he was driving about the State enjoying his leave, which would not be over until after we were to sail. It occurred to me that he might be located with a little help from the Division of Highways, the Highway Patrol and Motor Vehicle Department. I telephoned District Highway Engineer E. E. Wallace at San Diego and asked him to get Frazee's car license from Motor Vehicles. Mr. Wallace went to work on the matter, the Highway Patrol issued an all-points bulletin to pick up Frazee and give him the word to get back to his ship. In less than half an hour he was located and within a couple of hours was aboard ship and ready for sea."

FROM EGYPT

AHMAD KARIN
Roads and Bridges Department
Cairo, Egypt

Kenneth C. Adams, *Editor*
California Highways and Public Works
Sacramento, California

Dear Mr. Adams: I hope you are enjoying good health and a happy life.

There is no doubt that your magazine is a valuable one. It is considered international. We hope that we shall continue to receive the magazine in the future.

Best wishes, kindest regards.

Yours very truly,

A. Karin

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director

HIGHWAY COMMISSION

C. H. PURCELL	Chairman
HARRISON R. BAKER	Pasadena
HOMER P. BROWN	Placerville
JAMES A. GUTHRIE	San Bernardino
F. WALTER SANDELIN	Ukiah
CHESTER H. WARLOW	Fresno
CHARLES T. LEIGH	San Diego
R. C. KENNEDY, Secretary	Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY	State Highway Engineer
R. M. GILLIS	Deputy State Highway Engineer
CHAS. E. WAITE	Assistant State Highway Engineer
EARL WITHYCOMBE	Assistant State Highway Engineer
F. W. PANHORST	Assistant State Highway Engineer
J. W. VICKREY	Assistant State Highway Engineer
R. H. WILSON	Assistant State Highway Engineer
T. E. STANTON	Materials and Research Engineer
GEORGE F. HELLESOE	Maintenance Engineer
E. T. TELFORD	Engineer of Design
F. N. HVEEM	Construction Engineer
H. B. LA FORGE	Engineer of Federal Secondary Roads
L. V. CAMPBELL	Engineer of City and Cooperative Projects
EARL E. SORENSON	Equipment Engineer
H. C. McCARTY	Office Engineer
J. C. YOUNG	Traffic Engineer
J. C. WOMACK	Planning Engineer
J. P. MURPHY	Principal Highway Engineer
E. J. SALDINE	Principal Highway Engineer
I. O. JAHLSTROM	Principal Bridge Engineer
STEWART MITCHELL	Principal Bridge Engineer
E. R. HIGGINS	Comptroller

Right of Way Department

FRANK C. BALFOUR	Chief Right of Way Agent
E. F. WAGNER	Deputy Chief Right of Way Agent
GEORGE S. PINGRY	Assistant Chief
R. S. J. PIANEZZI	Assistant Chief
E. M. MacDONALD	Assistant Chief

District IV

JNO. H. SKEGGS	Assistant State Highway Engineer

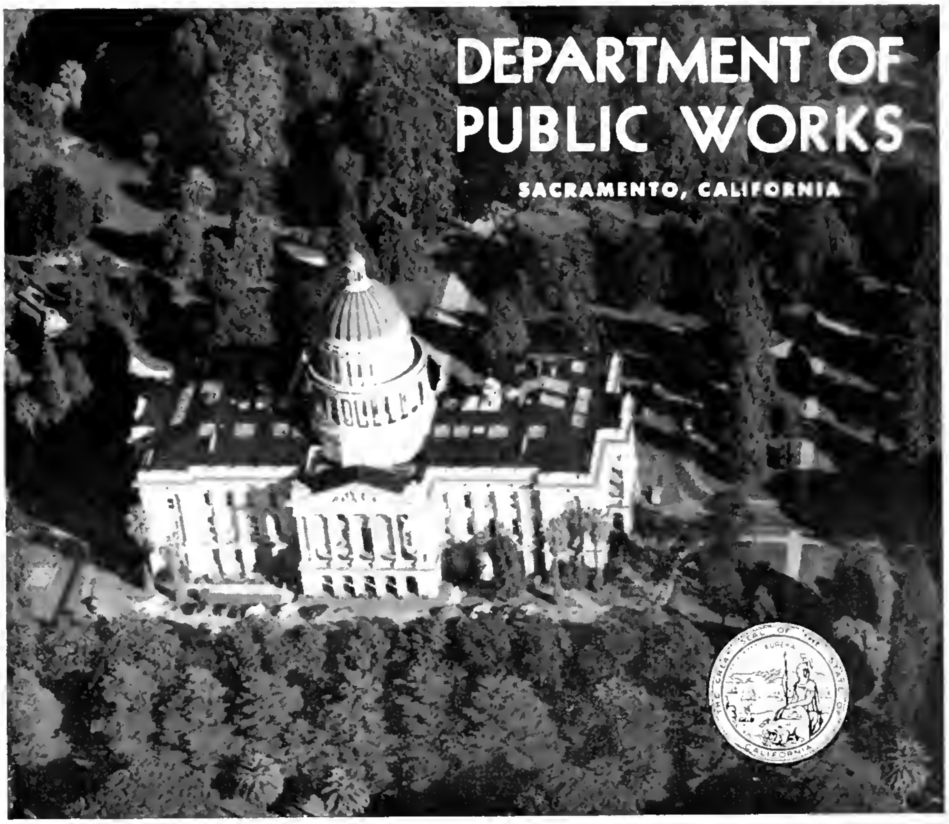
District VII

P. O. HARDING	Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH	District I, Eureka
J. W. TRASK	District II, Redding
CHARLES H. WHITMORE	District III, Marysville
B. W. BOOKER	District IV, San Francisco
L. A. WEYMOUTH	District IV, San Francisco
E. J. L. PETERSON	District V, San Luis Obispo
E. T. SCOTT	District VI, Fresno
W. L. FAHEY	District VII, Los Angeles
M. E. CESSNA	District VII, Los Angeles
S. W. LOWDEN	District VIII, San Bernardino
ALAN S. HART	District IX, Bishop
JOHN G. MEYER	District X, Stockton
E. E. WALLACE	District XI, San Diego
HOWARD C. WOOD	Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge



DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED	Chief
GEORGE C. HADLEY	Attorney
HOLLOWAY JONES	Attorney

DIVISION OF SAN FRANCISCO BAY TOLL CROSSINGS

NORMAN C. RAAB	Project Design Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON	State Engineer, Chief of Division
P. H. VAN ETTEN	Assistant State Engineer
W. H. HOLMES	Principal Engineer, Design and Construction of Dams
G. H. JONES	Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. B. WADDELL	Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER	Principal Hydraulic Engineer, Water Rights
HARVEY O. BANKS	Supervising Hydraulic Engineer, Water Pollution Control Investigations
WILLIAM BERRY	Supervising Hydraulic Engineer, California Water Plan
MAX BOOKMAN	Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER	Principal Attorney
T. R. MERRYWEATHER	Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD	State Architect
H. S. HUNTER	Deputy Chief
ROBERT W. FORMHALS	Administrative Assistant to State Architect
EARL W. HAMPTON	Supervisor of Contract Architects

Administrative Service

W. K. DANIELS	Assistant State Architect, Administrative
WADE O. HALSTEAD	Principal Estimator of Building Construction
CARLETON PIERSON	Supervising Contracts Writer

Planning and Design Service

P. T. POAGE	Assistant State Architect, Design and Planning
A. F. DUDMAN	Principal Architectural Designer
CARL A. HENDERLONG	Principal Mechanical and Electrical Engineer
C. L. IVERSON	General Supervising Architectural Draftsman
ELLIOTT ADAMS	Architectural Property Analyst
WALTER E. LORD	Supervising Specifications Writer
JAMES A. GILLEM	Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT	Chief Construction Engineer
F. A. JOHNSON	Principal Structural Engineer
JOHN S. MOORE	General Construction Supervisor
NATE W. DOWNES	Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN	Area I, Oakland
W. H. EPPERSON	Area II, Sacramento
FRANK R. AUSTGEN	Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD	Area I, San Francisco
M. A. EWING	Area II, Sacramento
H. W. BOLIN	Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 41262 4-51 29M

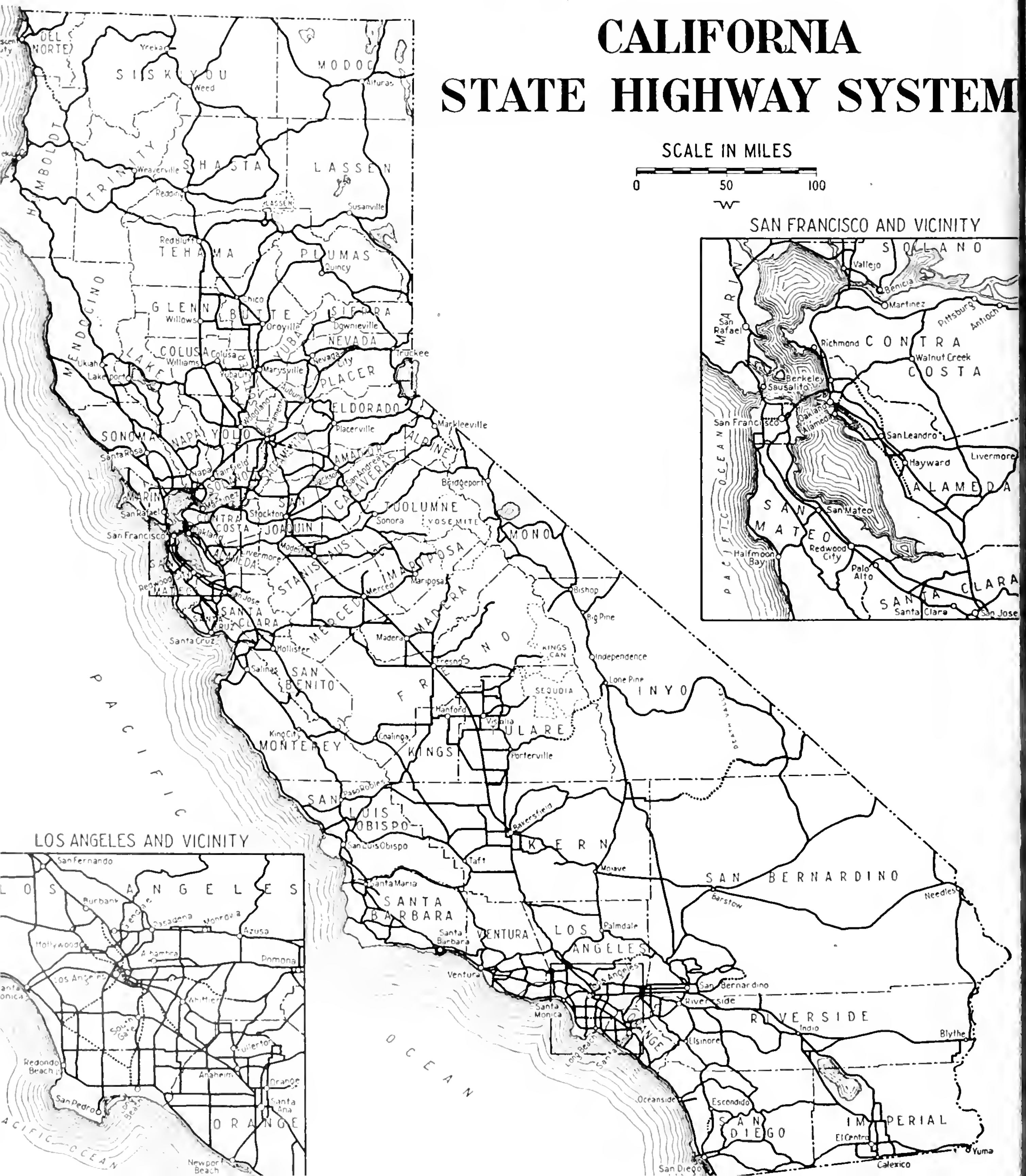
California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

Seattle Public Library,
Seattle,
Wash.

CALIFORNIA STATE HIGHWAY SYSTEM



Calif.
Highway Div

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

CHARLES H. PURCELL
Director

GEORGE T. McCOY
State Highway Engineer

KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. BOX 1499
Sacramento, California

Vol. 30 May-June Nos. 5, 6

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

Bayshore Freeway

First Unit Within City of San Francisco Opened to Public Use

"To your use and the use of the citizens of this community and its environs and to the use of the visitors and guests here assembled, we dedicate this freeway. May it ever be used with pleasure, profit and safety."

With these words, Highway Commissioner Chester H. Warlow of Fresno, on Friday morning, June 1st, officially opened to traffic the first unit of the Bayshore Freeway within the City of San Francisco. Warlow represented Director of Public Works C. H. Purcell, Chairman of the California Highway Commission.

CHESTER H. WARLOW
State Highway Commissioner

With Mayor Elmer E. Robinson and city and county officials of San Francisco, engineers of the Division of Highways and U. S. Bureau of Public Roads and several hundred interested spectators in attendance, dedicatory ceremonies were held at 25th and Vermont Streets. The project itself extends from Augusta Street to 25th Street.

Other Units Scheduled

Warlow was the principal speaker at the celebration which was arranged by the San Francisco Chamber of Commerce. President Lowrey of that organization introduced the speakers, among whom were State Highway Engineer George T. McCoy, Guy F. Atkinson, whose company was contractor on the project, as well as Mayor Robinson and Commissioner Warlow. Mayor Robinson cut a red ribbon stretched across the freeway, signaling its opening to public use.

McCoy expressed the hope that construction will start soon on two other units of the freeway, from 18th Street to Bryant Street and from Army to 17th Street. Future plans call for the construction of the freeway from San Francisco to San Jose, a distance of 33 miles.

First Unit in San Francisco

The project opened on June 1st is the first unit of the freeway completed in San Francisco. It is 1.3 miles in length, extends from Augusta Street on the south to 25th Street on the north, and was awarded to Guy F. Atkinson Co. and Chas. L. Harney, Inc., on May 11, 1949.

The construction cost was $3,450,000 and the cost of right of way, including clearing of improvements and utilities, was $3,400,000, or a total of $6,500,000.

The freeway consists of an eight-lane divided roadway, crossing over the city street network at the Army Street and Alemany Boulevard intersections, where street level traffic is distributed to and from the freeway by on and off ramps, and local street traffic is segregated and distributed through traffic circles at the street levels.

The structures over Army Street and Alemany Boulevard are structural steel bridges 643 feet and 758 feet in length.

The freeway crosses over Courtland Avenue on a reinforced concrete bridge 132 feet in length.

A pedestrian underpass crosses under the freeway at Faith Street, connecting Holladay Avenue on the west with Bayshore Boulevard on the east.

The structural design of the roadway is eight-inch Portland cement concrete pavement on one foot of imported borrow; the top four inches of which has been cement treated.

The traffic lanes are 12 feet wide, bordered at the shoulder line with rolled gutters and paved shoulders.

A six-foot minimum curbed division strip separates the lanes of opposing traffic.

The ramp connections are paved with plant mix surfacing for color contrast.

COL. JNO. H. SKEGGS
Assistant State Highway Engineer

Illumination is provided at all points of interchange and for lighting directional signs.

Traffic signals are installed at both ends of the freeway to control movement to and from city streets and make connection with old Bayshore Highway.

The construction of this unit consumed approximately two years and was financed from state highway, gas tax and federal aid funds.

In planning this project, which was constructed under the direction of Col. Jno. H. Skeggs, Assistant State Highway Engineer, with headquarters in San Francisco, extensive study was

made relative to the serious traffic problems, the number of going business establishments that would be affected by construction and the surface and underground utility obstructions. The work of removing factories and other buildings began more than two years before the advertisement of the contract and many of the utilities were relocated during this period.

Difficult Traffic System

The traffic situation was made much more difficult by the bridge construction by the City of San Francisco at the structures were driven to depths up to 100 feet.

Commissioner Warlow Speaks

Highway Commissioner Warlow said in part:

"I stand before you today doubly honored, honored in that I have been invited to address you on this auspicious occasion. Doubly so in that I am asked to speak in the place and stead and on behalf of that distinguished gentleman, Charles H. Purcell, Chairman of the California Highway Commission and Director of Public Works,

Aerial photograph of newly completed section of Bayshore Freeway in San Francisco

Unique City

"San Francisco is a unique city, a city of history and hills, of fixed boundaries and big bridges, of beautiful bays and lovely vistas. It is a city where almost every foot of privately owned land is occupied by a business or residence structure; a city whose only lateral expansion, paradoxical as it may seem, will occur in the areas beyond its legal limits. It is a city where

Mayor Elmer E. Robinson snips ribbon, officially opening new unit of Bayshore Freeway. LEFT TO RIGHT: Alan J. Lowrey, President, San Francisco Chamber of Commerce; Mayor Robinson, Highway Commissioner Chester H. Warlow; State Highway Engineer George T. McCoy, Highway Commissioner F. Walter Sondelin.

Islais Creek and Third Street, which closed one of the other main arteries for through traffic between San Francisco and the peninsula area, thereby greatly increasing the amount of traffic which had to be handled through construction.

Alemany Boulevard is located on an area that at one time was part of the meandering Islais Creek and, as industries became established in this area, more and more of the delta land was filled up with refuse and at a later date a shallow crust of poor fill material was placed. It was necessary to remove large quantities of this unsatisfactory material prior to beginning construction of the various roadways for the planned rotary, and pilings to support

who is unable to be with us today. Mr. Purcell has asked me to convey to you, and all of you, his greetings and best wishes. This I do with great personal pleasure.

"Charlie Purcell would have enjoyed being here today, for no man is more interested in, or concerned with the traffic problems and welfare of this community than he. He would have especially enjoyed this day, for it is the first occasion when this city and its civic organizations have publicly noted the importance of the California Freeway System now under construction, and joined in the festivities celebrating the completion of a major project on that system within its boundaries.

almost one-fifth of its workers leave the place of their labors and daily retire to another community to spend the hours of their refreshment and repose.

"Such a city has traffic problems, and as this city expands, building skyward as it must, those problems will become even more acute than they are now. We therefore must build not only for the present but for the future as well, that major operations, presently necessary, will not of necessity be repeated at an early date.

Colossal Job

"To provide transportation facilities for a major city is a colossal undertaking, and the highway part of that, the portion which falls to our lot, is


ALEMANY BLVD.
BAY
SHORE
BLVD.
AVE.
HOLLADAY
PERALTA
MARIN
ST.
ARMY ST.
SAN BRUN

This aerial view of Bayshore Freeway is looking toward the San Francisco-Oakland Bay Bridge with which the freeway ultimately will connect

no mean job either physically, as you can see, or financially, as you shall hear.

"This day others will address their attention to the details of the physical and financial aspects of this particular project, whose completion we here note; but I choose to observe that though it is only 1.3 miles long, yet the right of way, the road bed, the structures and ramps, have cost a total of $6,500,000. And as we extend this freeway into the heart of the city, there is yet more to come, or should I say, more to go.

"I choose rather to direct your attention to the over-all state-wide picture of the highway problem and San Francisco's position in that picture.

Some Financial Facts

"Prior to 1947 the Department of Public Works was receiving for purchase of rights of way and for highway construction about $23,000,000 per year. Out of the Legislature during that session, with the aggressive backing of our Governor Earl Warren, came the Collier-Burns Highway Act of 1947. At that time the critical deficiencies on the State Highway System, measured in money, amounted to $1,700,000,000. During the first five years of operation under this law, there has been spent or allocated for spending this next fiscal year a total in excess of $460,000,000 for rights of way and new construction. Of this amount, more than $33,000,000 was assigned to San Francisco, and more than $111,000,000 was allotted to this highway district which is in charge of Colonel Jno. H. Skeggs, Assistant State Highway Engineer.

Millions Required

"This freeway, today open for traffic, is not an isolated section of state highway, but is an important project on the Bayshore Freeway leading from San Jose to San Francisco. It is but a part of a well-planned program of progressive construction on this state route, which is one of the major arteries of travel in California.

"Upon this over-all undertaking we have constructed, under construction, or budgeted for immediate construction in the first five-year period, a total of 16.4 miles at a cost of over $30,000,000. There yet remains an additional 33 miles of freeway

... Continued on page 39

Ground Broken

Construction of Colorado Street Bridge in Pasadena Is Started

By R. C. KENNEDY, Secretary, California Highway Commission

ACTIVE CONSTRUCTION of the Colorado Street Bridge, between Pasadena and the Eagle Rock section of Los Angeles, was officially started at 10.30 a.m. on May 3, 1951.

The contractors, Guy F. Atkinson Company, built a speakers' stand on the site and had one of their largest Diesel shovels parked alongside. Jake Billy, master mechanic for the Atkinson Company, was in charge of the shovel and promised to put it practically any place anybody wanted it so that good pictures could be obtained.

State Highway Engineer George T. McCoy

Before the actual ceremonies started, pictures of Highway Commissioner Harrison R. Baker, and State Highway Engineer George T. McCoy, were taken, officially starting the first ground-breaking.

Pasadena Radio Station KWKW had a tape recording machine and rebroadcast the ceremonies that afternoon.

John W. Holmes, Chairman of the Community Development Committee of the Pasadena Chamber of Commerce, acted as master of ceremonies and introduced A. J. Hay to start the proceedings. Hay represented the Board of Directors of the Pasadena Chamber of Commerce.

A. Ray Benedict, Mayor of Pasadena, welcomed the people attending the ceremonies and complimented the Highway Commission and the Division of Highways for starting to improve transportation over the Arroyo Seco.

Roger W. Jessup, Chairman of the Los Angeles County Board of Supervisors, had arrived in Los Angeles at 7.30 that morning from Hawaii and came directly to Pasadena to attend the ground-breaking ceremonies. He was the next speaker introduced by Master of Ceremonies Holmes.

State Highway Engineer McCoy, F. W. Panhorst, Assistant State Highway Engineer in charge of bridges, and P. O. Harding, Assistant State Highway Engineer in charge of District VII, were the next three speakers. Each one, in turn, spoke of and credited several of their assistants for the part everybody had played in the design of this new bridge.

The author was called upon to introduce D. E. Root, Vice President of the Guy F. Atkinson Company, who gave some interesting figures on the amounts of concrete, steel, and wood necessary to build the bridge. Root introduced his chief engineer, his controller, and R. K. Boyd, who is the superintendent of the new job.

Charles T. Leigh and Chester H. Warlow, members of the California Highway Commission, were then introduced and each spoke a few words. Commissioner Baker was the last speaker on the program.

Youthful Contractor

A bit of human interest was injected into the program when it was noticed that a young fellow, just four years old, had decided that he was going to help break ground for the new bridge. His mother had brought him over from Glendale and when he found out they were going to a ground-breaking ceremony, he decided to bring his own shovel with him. He was spotted quite a ways from the crowd busily operating his toy shovel and was immediately pounced on by all the photographers present. His shovel was transported to a pile of dirt almost immediately beneath the big shovel and the photographers had a field day shooting pictures of the youngster. After the ceremonies were over, some of the news photographers had Baker pose with the youngster and his miniature shovel.

Assistant State Highway Engineer F. W. Panhorst

After the ceremonies were completed, a group of invited guests gathered at the Brookside Golf Club for lunch where a few words were spoken by representative members of civic bodies.

In his address, Commissioner Baker said, in part:

New Era of Progress

"This great new bridge crossing the Arroyo Seco, replacing or supplementing the beautiful, old Colorado Street Bridge, will be practical in the increased service it will render, massive in its construction and beautiful in appearance—truly a monumental structure.

"But we feel, and hope, that it will be more than this—that it will become also a symbol commemorating the commencement of a new era of progress for Pasadena and this foothill area and be another great milestone in the march toward building the integrated system of metropolitan freeways so badly needed to weld together, and to serve, the communities of Southern California.

"We are standing on historic ground. It was here that Pasadena started. On a sunny day, January 27, 1874, some 77 years ago, on this same bank of the Arroyo Seco, only two blocks to the north of this spot, the members of the 'San Gabriel Orange Grove Association,' also known as The Indiana Colony, met and allocated the lands of the colony in the Rancho San Pascual, each member selecting an individual site, varying from 15 to 80 acres in size. Each site carried with it a 'wood lot' in the Arroyo Seco Canyon of from three to seven acres. It may be of interest that the association had just purchased its 4,000 acres of the Rancho San Pascual in December from Dr. John S. Griffin in 1873, for a total price of \$25,000 and the choice sites were allocated among the members at a price of \$30 per acre. The "wood lots" were sold at prices from \$20 to \$50 each.

Pasadena Founded

"There were only 17 members of the association present, representing 28 original purchasers, on that memorable day in January, 1874. There were not many, but they were men of courage and vision. And that day they founded Pasadena.

UPPER—Budding young contractor, four-year old Scott Whitaker of Glendale, brought his own shovel to the ground-breaking ceremony. LOWER—State Highway Commissioner Harrison R. Baker congratulates Scott on his efforts.

"Today we are taking another step forward.

"This new bridge crossing the Arroyo Seco will be a great structure and a useful one. The need for a new bridge has long been apparent, in order to solve the congestion on the present Colorado Street Bridge and to provide a safe, convenient and attractive freeway approach to Pasadena from the west.

"It will be an imposing structure; the largest bridge ever constructed by the Division of Highways in the State of California, and the largest nontoll structure ever built in the State. The contract for the bridge, which has been awarded to Guy F. Atkinson Company at a cost of \$3,389,650, is the largest single contract ever awarded by the Division of Highways. Other freeway

... Continued on page 44

Venture Success

Safeway Stores Finds That Freeway Benefits Its New Vallejo Business

By WAYNE HUBBARD, District Right of Way Agent

The old bromide about customers beating a path to your door if you build a better mousetrap seems an apt expression to use in connection with the subject of freeways. The subject—which has tended to flame many controversies over the effects of freeways upon businesses located on adjacent secondary highways—unquestionably is an important one.

Evidence thus far recorded supports the contention that people will seek out a business if the effort is worthwhile—that is, if the place has what the customer desires.

The question that has led to controversy generally is summed up thus: "What happens when traffic—as on a freeway—must travel quite a distance beyond a business location before being able to turn off the road?"

The answer, obviously, is difficult unless one pins the question down to specific cases. In other words, a great deal depends on the nature of the business involved, the attractiveness of the site, how many other business enterprises are centered there, and so forth.

Vallejo Example

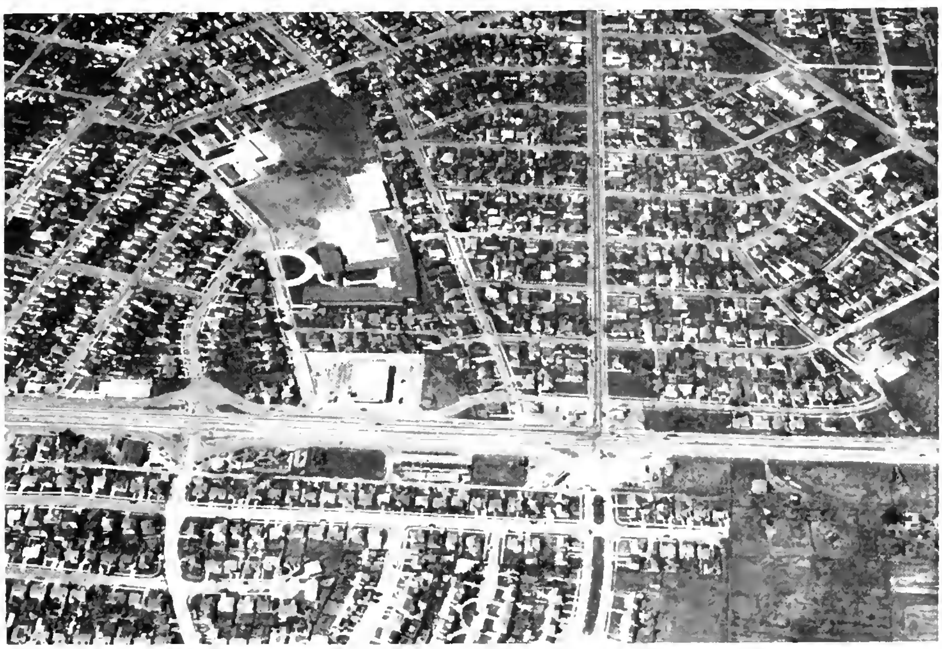
A recent addition to the mounting score of examples is a new retail food store constructed in Vallejo by Safeway Stores, Incorporated. The store is located on Highway No. 40, a freeway along the eastern section of Vallejo. Actually, though facing the main highway, the store fronts on Curry Street, a secondary road paralleling the freeway. Another factor adding to the interest of this venture: the site chosen by Safeway is not contiguous to any centralized business area. However, while standing virtually alone, the store does have an apparent advantage of being on the west side of the freeway where the bulk of Vallejo's population is gathered.

Safeway operates over 2,000 retail food stores in 23 of the states, coast to coast, and in five Canadian provinces, and is at present engaged in a multimillion dollar store construction program. Each of the new food stores, with ultra modern equipment and facilities, represents an investment of approximately \$250,000. While exterior designs of the new stores may vary (in some cases to blend with distinctive architectural styles of a community), and differ in size, the Vallejo store is somewhat typical of the modern Safeway units being constructed.

. . . Continued on page 43

Looking north on US 40, showing new Safeway Store located off freeway on Perry Street in Vallejo. Note absence of other business enterprises, thus making the Safeway entry an interesting experiment as to the effect, if any, of freeways upon retail food store patronage.

Aerial view of Safeway Store in Vallejo. Store is located near center of photo. Note cars parked in area which provides parking facilities for 138 cars.



Thomas E. Stanton

Retires With International Renown After 39 Years

By F. N. HVEEM, Materials and Research Engineer

On May 31, 1951, Thomas E. Stanton, Materials and Research Engineer of the Division of Highways, reached the age of 70 and therefore automatically became an heir to the benefits and privileges of the State Retirement System for the creation of which

THOMAS E. STANTON—1951

he himself was largely responsible. Mr. Stanton was in state service for more than 39 years, his name first appearing on the pay roll of the California Highway Commission on April 1, 1912, at which date he was appointed Assistant Division Engineer, Division VI, with headquarters in Fresno.

In 1912 the California Highway Department was in its infancy and the initial work was being planned and organized. Prior to that time Stanton had served as Assistant Engineer in the City Engineer's Office in Los Angeles for a period of seven years, and after entering the employ of the State he served successively as Assistant Division Engineer, then as Assistant State Highway Engineer, and finally, Materials and Research Engineer from 1928 until his retirement at the end of May, 1951.

Pioneer Family

Tom Stanton was the first native son of a pioneer family and the third by the name of Thomas Elwood Stanton. His grandfather, Thomas Elwood Stanton, the first of the name, had crossed the plains to California during the gold rush in 1849. Having left a wife and eight children at home, he soon became homesick and returned to Indiana, where he spent the next eight years trying to persuade the entire family to move to California, which was finally accomplished in 1859, after a sojourn in the northeastern part of Iowa where Thomas Elwood Stanton the second was born, near Frankville on April 2, 1854. After the usual hardships attendant upon the long trip across the plains by wagon train, the family finally settled in Santa Barbara, in the area now known as Miramar.

Thomas Stanton the second moved to Los Angeles where he became one of the leading photographers of the era, having studios in the Temple and Downey Blocks at Main and Temple Streets. It was there that Thomas Elwood the third was born on Temple Street between Spring and Broadway, on May 31, 1881, the centennial year of the city. Tom grew up in Los Angeles, attended grammar schools and later graduated from St. Vincent's College in 1889 with the degree of A.B. He then attended the University of California at Berkeley entering in 1889 with the class of 1903. Because it was necessary to work during a portion of his college years, he did not graduate until 1904, receiving a B.S. degree in mining.

Joins Division of Highways

Having no immediate opportunity to follow mining as a profession and having passed a civil service examination as instrument man in the City Engineer's Office in Los Angeles, he went to work for the city in 1905. After seven years with the Los Angeles City Engineer's Office, during which he served successively as instrument man,

THOMAS E. STANTON—1912

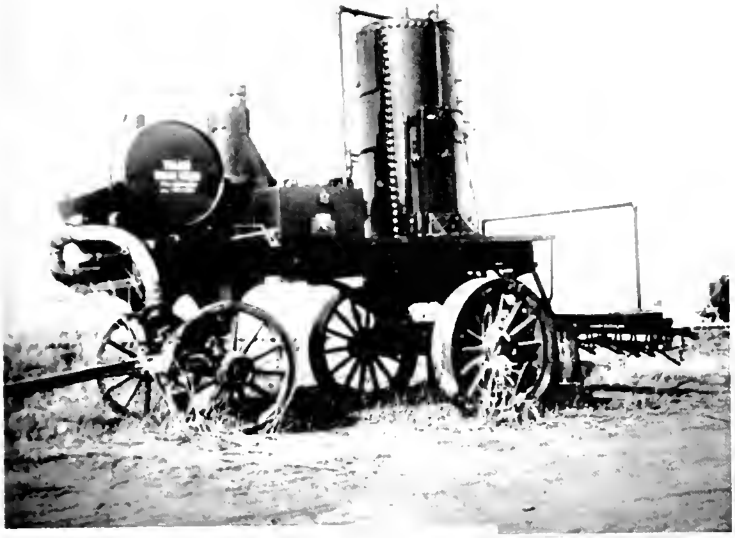
chief of party and as assistant engineer in charge of sewer and paving design and construction, he was lured away by the rosy prospects offered by J. B. Woodson, the new Division Engineer of the California Division of Highways, who offered him an increase of \$5 per month if he would accept the position of Principal Assistant Division Engineer with headquarters in Fresno. Thus, the first pay roll shows that he received a salary of \$150 per month in April of 1912.

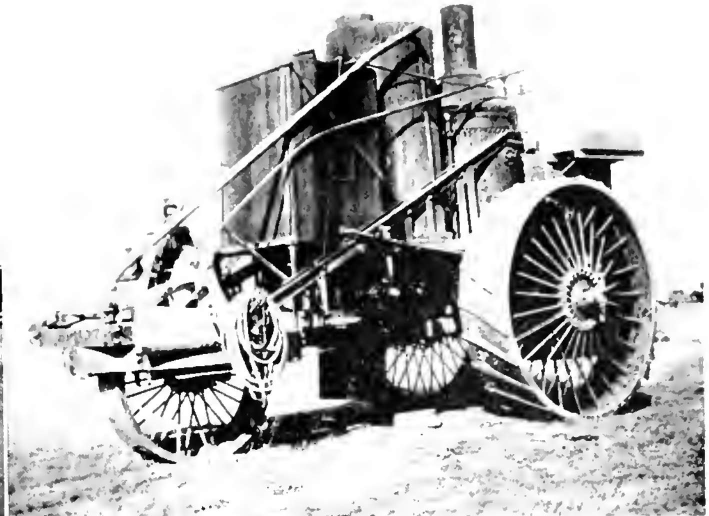
Earns Promotion

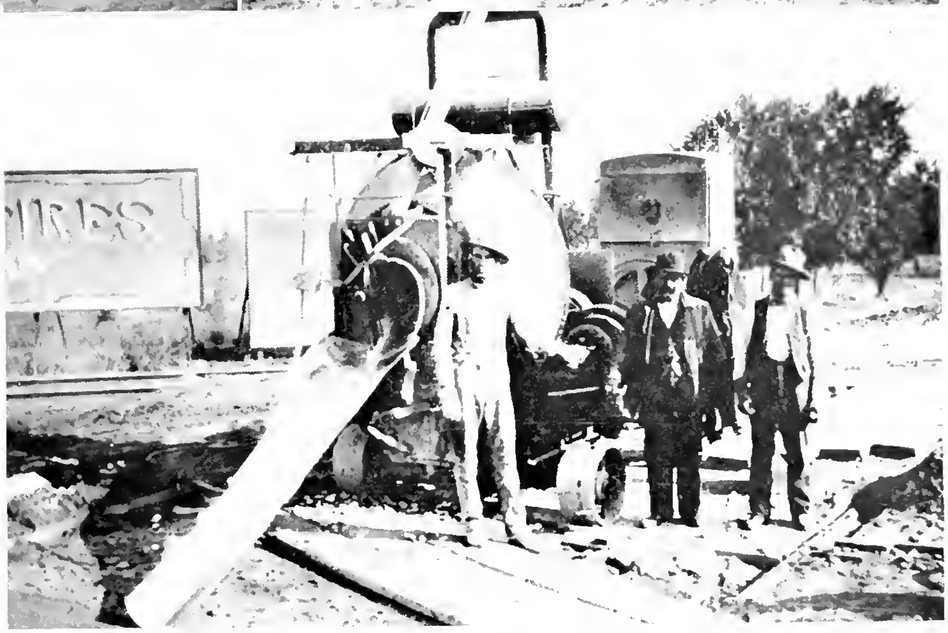
Tom once stated that during the time when he was Assistant Division

Engineer in Fresno he made it a point to be as well informed on the details of headquarters operations as anyone actually in the department at Sacramento. It may be suspected that this fact was responsible for his appointment in 1914 to the position of Principal Assistant Division Engineer in Sacramento. In 1920 he was made Assistant Highway Engineer in charge of general inspection throughout the southerly portion of the State. In 1921, when the Department of Public Works was formed, Mr. Stanton was appointed Assistant State Highway Engineer, in which capacity he served under State Highway Engineers Austin B. Fletcher, Robert M. Morton and Charles H. Purcell until his appointment as Materials and Research Engineer in 1928, which position he occupied for the succeeding 23 years until his retirement on May 31, 1951.

In the earlier years of the Division of Highways, a great many interesting and often colorful experiences were the lot of the pioneering engineers. Ruts and chuckholes were synonymous with roads in those days, and pavements were virtually unheard of outside the limits of incorporated cities. The sums of money available for highway construction and improvement were small indeed compared to modern standards, and everyone in the organization was very close to the problem which often meant being intimately mixed with the mud and dust of the rural roads.







UPPER LEFT—Tomer road oiler used on US 99 in Madera on one of Stanton's early jobs in 1912. UPPER RIGHT—Traction engine used on US 99 in Madera in 1912. LOWER—Foote one-sack paving mixer used on US 99 in Fresno, 1912, and superceded later by two-sack mixer, which was considered the ultimate in mixer size.

Times Do Change

The records show that a seminar of department heads was held in Sacramento May 26th and 27th in 1914, and among the various papers presented was one on accounting by Mr. J. H. Small, Chief Accountant. Mr. Stanton was selected to discuss the paper, and his comments on the organization of the District office work carry the following rather illuminating paragraph: "A variety of such forms makes it possible for one employee who is both clerk and stenographer to handle *all of the clerical work of the division office.*" Times have indeed changed.

The pioneering urge was obviously strong in the Stanton family, and it appears that Tom inherited a full measure of the energy and initiative that led his namesake to move to California in the days of '49. Thomas Elwood the third has continued to pioneer, and the catalog of his activities represents an extensive and impressive list. It is indeed difficult to sum up in any brief or simple phraseology the impressions and far reaching effects produced throughout the lifetime of an energetic and

RESOLUTION OF APPRECIATION

WHEREAS, On January 15, 1950, Thomas Elwood Stanton completed over 18 years of service as a member and from 1934 to 1950 as President of the Board of Administration, California State Employees' Retirement System; and

WHEREAS, The State Employees' Retirement System started in January, 1932, with approximately 14,000 members and has since grown to include approximately 100,000 members, and

WHEREAS, The System has now invested in excess of 160 millions of dollars, without the loss of one penny in interest or principal during all of the time, due to the good judgment of the members of the Board of Administration; and

WHEREAS, This service of Mr. Stanton as member and president of the board has been given without thought of financial return to himself; and

WHEREAS, The Retirement System, under the leadership of Mr. Stanton and his associates on the Board of Administration has been beneficial to thousands of state employees; therefore, be it

Resolved, That the General Council of the California State Employees' Association, assembled in Long Beach, California, February 11, 1950, hails Thomas Elwood Stanton as a true friend and leader, in whose debt they shall always be for his service in behalf of the Retirement System.

1949 OFFICERS	1950 OFFICERS
President	
W. Rex Servoss	Stanley B. Fowler
Past President	
F. M. Carter	W. Rex Servoss
Vice President	
Stanley B. Fowler	Thomas A. Stead
Secretary-Treasurer	
Charles Smith	Charles L. Smith
Director of Law and Legislation	
Theodore H. Jenner	A. W. Hislop
Director of Civil Service	
A. W. Hislop	T. W. Martin
Director of Public Relations	
Dale B. Frady	Dale B. Frady

capable man devoted to his work and to the public interest.

In addition to other honors for notable contributions he was awarded the Wason Medal in 1934 and the Norman Medal in 1943, both for outstanding work on Portland cement concrete.

Gained Wide Renown

While many research projects have been conducted in the Materials and Research Department which have attracted attention in engineering organizations through the United States and in foreign countries around the world, he is probably best known for work on the durability of Portland cement concrete, and among the various aspects of the durability problem. Mr. Stanton was the first to discover that one of the most marked forms of deterioration in Portland cement concrete was attributable to an internal reaction between constituents in the cement and in the aggregate. In other words, certain brands of Portland cement may contain small percentages of alkalis which cause no trouble unless the sand used contains certain minerals such as opal or similar forms of silica which will react with the alkalis in the cement.

In addition to professional activities, much of which were devoted to the committees having to do with retirement benefits, membership qualifications and professional conduct, Tom was also a member of the Committee on Salaries for the American Society of Civil Engineers, and his interest in the welfare of civil engineers and public employees in general is illustrated by his activities in community affairs such as the Red Cross, Community Chest, Boy Scouts, etc., and most noteworthy of all, of course, are his outstanding efforts and achievements in organizing the State Employees' Association and supervising the development and form of the Employees' Retirement System through its early days, until it became firmly fixed in the State law of California in a manner that renders it free from political manipulation or unfavorable influence.

Those who have had occasion to observe Tom in action during employee meetings or those of other groups have

. . . Continued on page 52

RESOLUTION IN HONOR OF THOMAS ELWOOD STANTON

WHEREAS, The approaching retirement of Thomas Elwood Stanton has come to the notice of Chapter 2 of the California State Employees' Association; and

WHEREAS, Mr. Stanton is a charter member of this chapter and is one of those engaged in the preliminary steps leading to the organization of the California State Employees' Association, and of Chapter 2 of the association; and

WHEREAS, Mr. Stanton has served the employees of the State in many important capacities, including chairman of the Campaign Committee for a State Retirement System; first president of the California State Employees' Association; chairman of the Civil Service Constitutional Committee; member and president of the Board of Administration, State Employees' Retirement System; Delegate to every meeting of the General Council of the California State Employees' Association; and

WHEREAS, Mr. Stanton in his profession as an engineer has held high and important stations in the Division of Highways of this State; and

WHEREAS, Mr. Stanton has received national and international recognition for his work as an engineer, as shown by his holding national office in engineering organizations and by the publication of articles on engineering practices which have been recognized by merit awards from national engineering societies; therefore, be it

Resolved, That Thomas E. Stanton be congratulated for his achievements, for his contributions, and leadership, and that he be informed by the passage of this resolution of the esteem and good will in which he is held by the members of this association; and be it further

Resolved, That a copy of this resolution be presented to Mr. Stanton at the public meeting to be held in his honor in the City of Sacramento, California, May 25, 1951.

SACRAMENTO CHAPTER NO. 2
CALIFORNIA STATE EMPLOYEES ASSOCIATION
By HERBERT G. GASKILL,
President, 1951

F. N. HVEEM

F. N. Hveem, the new Materials and Research Engineer, has succeeded to the position after serving more than 20 years in the Materials and Research Department in various capacities which under present civil service terminology would range from Assistant Highway Engineer to Principal Engineer. Hveem is a home-grown product in every sense of the word, having been born in Shasta County, California, February 8, 1898. He claims vivid recollections of an early childhood spent in mining camps and of dwelling in log cabins.

F. N. HVEEM

He entered the employ of the State of California in November, 1917, at the age of 19 as a draftsman in the office of Division II, then located in Dunsmuir. The first state highway construction through the Sacramento Canyon was under way at that time, and Hveem was induced to take the job through the advice and assistance of Spencer Lowden, then Resident Engineer. After 13 years of miscellaneous experience which included Assistant Resident Engineer, then Resident Engineer, and Maintenance Superintendent, Hveem joined the staff of the Materials and Research Department in December, 1929. Since that time he progressed through the various civil service grades with positions of increasing responsibility to Supervising Materials and Research Engineer and principal assistant to Mr. Stanton.

Hveem was chiefly identified with the work on bituminous materials and pavement practices, expanding his activities into the realms of soil mechanics, soil materials and to concrete pavements. He is the author of over 20 papers on technical subjects, receiving the Highway Research Board award for the outstanding paper in 1948. He has been responsible for the development of a number of devices for testing materials, the best known of which is the Hveem Stabilometer which has been adopted for use in many states and foreign countries.

Hveem was appointed Construction Engineer in September, 1950, and leaves that position to take up the duties of Materials and Research Engineer, succeeding Mr. Stanton on June 1, 1951.

CAREER OF THOMAS E. STANTON

Born: May 31, 1881, Los Angeles, California.

Engineering Education: University of California, B.S. 1904.

Professional Record:

Assistant Engineer, City Engineers' Office, Los Angeles, April, 1905 to April, 1912. With the California Division of Highways April, 1912, to date serving successively as Assistant Division Engineer; Assistant Highway Engineer and Materials and Research Engineer. In charge of the Materials and Research Department since 1928.

Professional Society Record:

Member:

1. *American Society of Civil Engineers*
   (Assoc. M. '19; M. '20; Director '37-'39; Vice President '42-'43; Norman Medal '43). President Sacramento Section 1930. Chairman Society Meeting held in Sacramento 1930. Before and while on the Society Board of Direction, Member of Committees on (1) Aims and Activities (Forerunner Committee on Professional Objectives); (2) Retirement; (3) Membership Qualifications; (4) Professional Conduct; (5) Local Sections; (6) Professional Activities; (7) Honorary Membership; (8) Committee on Salaries (Chairman 1943).
2. *American Association of State Highway Officials*
   1945-6-7 Chairman of Committee on Highway Research Activities and Member of Committees on Standards and Materials.
3. *American Society for Testing Materials*
   Member numerous committees, including C-1, C-9 and D-4.
4. *Highway Research Board*
5. *American Concrete Institute*
   Member Board of Direction 1943-4. Wason Medal for noteworthy Research 1934.
6. *Association of Asphalt Paving Technologists*
   President 1942.
7. *American Road Builders Association*
   Vice President Western District 1948-49-50.
8. *Member U. S. National Committee on Soil Mechanics*
   Second International Conference on Soil Mechanics and Foundation Engineering --1948.
9. *Member Engineering Advisory Council of the University of California*
10. *Registered Civil Engineer, California*

Publications:

Author numerous technical papers and discussions contributed to and published by the A.S.C.E., A.A.S.H.O., A.S.T.M., H.R.B., A.C.I., A.A.P.T., and A.R.B.A., as well as by Technical Journals.

Non-Professional Activities

(1) Member at different times of the following Boards of Direction:
  (a) Sacramento Red Cross; (b) Sacramento Community Chest; (c) Sacramento Council of Boy Scouts; (d) Sacramento War Disaster Committee; (e) Board of Administration, State Employees Retirement System; 1931-1950 (President 1934-1950).

(2) Member, Board of Direction, Sacramento Town Hall (President 1947).

(3) Member Rotary, Serra and Sutter Clubs, Sacramento.

(4) Charter Member, University Club of Sacramento.

(5) Charter Member (1931) and First President of California State Employees' Association.

(6) Member Sacramento Memorial Bridge Committee 1927-31.

(7) President Knights of Columbus Hall Association, Sacramento.

DON G. EVANS

Don G. Evans has been appointed to the position of Construction Engineer effective June 1, 1951, to succeed F. N. Hveem. Mr. Evans brings to this position a long and varied experience in many fields of engineering, much of which has involved field work either on surveys and location or in construction activities.

Evans was born January 28, 1890, in Terre Haute, Indiana, and in 1911 graduated from Rose Polytechnic School in that city, receiving a B.S. degree in civil engineering. In 1912 he attended the Colorado School of Mines taking post graduate work in geology and mining. In the years following he was successively mining engineer in Central America and in Colorado and Arizona. From 1920 to 1927 he was with the U. S. Bureau of Public Roads on Forest and National Park roads in Arizona and New Mexico. After a year as superintendent for the J. C. Hirsch Company in Los Angeles, Mr. Evans entered the employ of the State as Locating Engineer in District VII, transferring to District VI in 1931. The next 10 years he was located principally in the Bakersfield area, handling all phases of work ranging from location to construction.

From 1942 to 1945 he was with the Corps of Engineers, U. S. Army, and was released from active duty with the rating of lieutenant-colonel on December 31, 1945.

In 1946 he became Construction Engineer for District VI, and from 1948 to the end of June, 1951, has served as Assistant District Engineer in charge of operations which has included general supervision over both construction and maintenance. He brings to the position of Construction Engineer many years of close and first-hand experience with all types of highway construction.

TOP—Tom Stanton (left) and Resident Engineer E. G. Sinclair inspect project on US 99 in Madera in 1912 during pick and shovel days of highway construction. CENTER—Winter hauling difficulties on same project. BOTTOM—Tamping concrete by hand in Fresno in 1912. The pavement on this project had an excellent service record even though only four inches thick.

GOOD HAND SIGNALS

Letting other drivers know what you want to do allows them an opportunity to give you the space you will need to make your turn or pull over to stop. Failure to signal your intentions makes it harder for other motorists to cooperate in preventing an accident.

Moving Forward

Los Angeles River Freeway Plans For Future Are Comprehensive

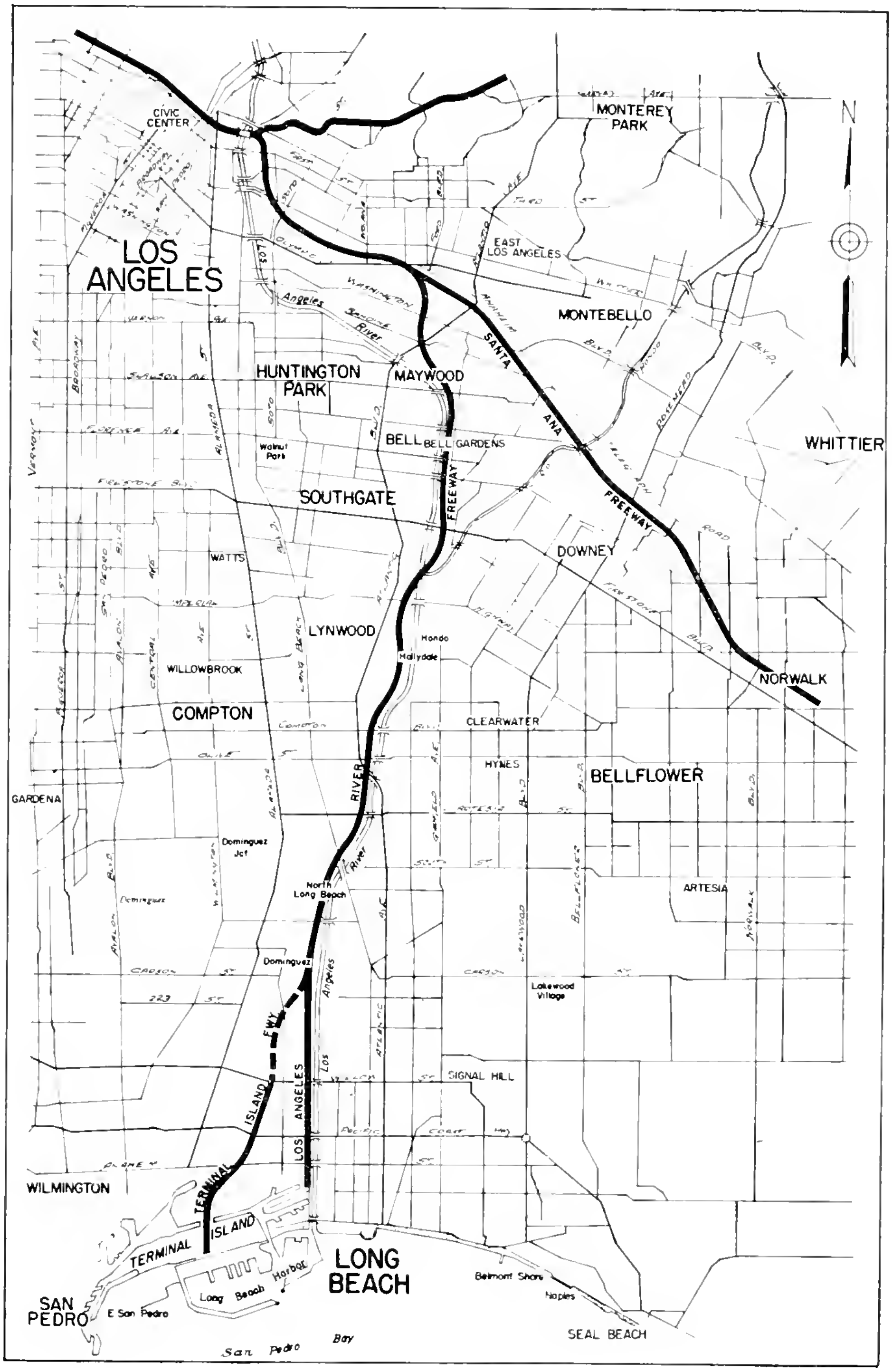
By M. E. CESSNA, District Engineer

THE LOS ANGELES RIVER FREEWAY,* 16.2 miles in length between Pacific Coast Highway (Route 60) and the Santa Ana Freeway (Route 166), had its inception about 14 years ago when it was proposed by the Long Beach City Engineering Department as a limited access highway to be built along the westerly side of the Los Angeles flood control channel to carry through traffic between the City of Long Beach and Los Angeles and other northerly points.

At that time this proposed limited access road was not on the State Highway System, but the importance of the project was recognized by Long Beach, Los Angeles County and the State Division of Highways, and the proposed freeway was approved for inclusion in the Long Beach major city street system. During the 1939-40 Fiscal Year the city budgeted $25,000 of major city street funds for the protection and acquisition of rights of way for this project and during subsequent years programmed from state gas tax funds, for expenditure on major city streets, a total of $160,000. In the 12-year interval that has elapsed since the first allocation of funds, a very considerable amount of valuable right of way has been obtained and many large industrial and housing projects that might have later proved obstacles to the development of this freeway have been forestalled.

Advance Planning

It is because of the foresight on the part of public-spirited citizens and officials of the City of Long Beach,



Vicinity map, showing the Los Angeles River Freeway and its connections with the Terminal Island Freeway and the Santa Ana Freeway

* A resolution was recently adopted by the Los Angeles County Board of Supervisors officially changing the name of the "Los Angeles River Freeway" to "Long Beach Freeway." Since many published maps available to the public over a period of many years have indicated the freeway located along the river as the "Los Angeles River Freeway," whereas the "Long Beach Freeway" has been the designation used for another freeway in this locality not on the State Highway System, it is quite likely that the freeway along the river that carries State Highway Route 167 will for some time to come of necessity be known as the "Los Angeles River Freeway."

Looking northerly along freeway location, showing buildings of the U. S. Army 822 Air Force Specialized Depot. The freeway passes between the electric power transmission line and the buildings.

working in cooperation with the Division of Highways, that so much of the advance planning and right of way acquisition for the Los Angeles River Freeway in Long Beach has been accomplished.

The accomplishment of Long Beach in providing for the Los Angeles River Freeway, before it was taken into the State Highway System, was not confined entirely to right of way acquisition. Long Beach provided for the construction of spans for the Los Angeles River Freeway at the time the bridge was built over the Los Angeles River for Willow Street. The County of Los Angeles made a similar provision in its bridge plan for the Belhart Street project.

Belhart Street Bridge

Belhart Street is a very important east-west thoroughfare and is a major highway on the Los Angeles County system. This county bridge project with road approaches cost in excess of $2,000,000 and was completed and opened to traffic on April 28, 1951. The length of separate bridge structure to provide separation openings for the

Looking southerly along Los Angeles River Freeway location north of Slauson Avenue, showing plant of the American Brake Shoe Company, which will be interfered with by freeway construction

Looking northerly along freeway from Pacific Coast Highway, showing storm drain construction by City of Long Beach to clear way for freeway

Los Angeles River Freeway was 224 feet.

Southerly Extension of Freeway

From Pacific Coast Highway southerly into the Long Beach Harbor area, the Los Angeles River Freeway is not on the State Highway System; however, the City of Long Beach is proceeding with construction financed with city funds. At the present time Long Beach has a contract under way for a bridge over the Los Angeles River at Anaheim Street, which provides a grade separation structure and interchange roadways with the Los Angeles River Freeway. Later this year Long Beach proposes to let another construction contract for the grading and paving of the Los Angeles River Freeway from Anaheim Street to Pacific Coast Highway. It is planned to extend construction from Anaheim Street into the harbor area as rapidly as funds become available.

Progress Northerly of Pacific Coast Highway

On April 26th, bids were opened in the Los Angeles Office of the Division of Highways for construction 2.5 miles in length on the Los Angeles River Freeway between Pacific Coast Highway and 223d Street. The Griffith Company was the low bidder. The low bid for the contract items was $1,429,146. This contract provides for grading, paving, incidental items and structure at Pacific Coast Highway.

Looking northerly along the freeway toward Willow Street, showing overcrossing grade separation previously built by City of Long Beach to accommodate freeway

View from Firestone Boulevard looking northerly along the Los Angeles River Freeway location, showing Richfield oil refinery which will be interfered with by freeway construction

Interchange roadways will be constructed at Pacific Coast Highway, at Willow Street and at Belhart Street. The pavement on the freeway roadways will be eight-inch thickness of Portland cement concrete pavement 36 feet wide placed upon four inches of cement treated subgrade and eight inches of imported subbase material. The central dividing strip between the northbound and southbound roadways is planned 12 feet in width and the area between the curbs is to be landscaped.

. . . Continued on page 51

View of recently completed Los Angeles county project providing new bridge across the Los Angeles River for Belhart Street, which included an overcrossing grade separation to provide for the Los Angeles River Freeway and the on-ramp for northbound traffic

17 Contracts

Hollywood Freeway Construction Under Way Is Extensive and Varied

By W. L. FAHEY, District Engineer

At no time since construction first started on the Hollywood Freeway in 1939 when the City of Los Angeles advertised and awarded a contract for the eight-lane freeway through Cahuenga Pass, has there been so much and so varied construction in progress as at the present time. The State Division of Highways now has active construction under way on 17 contracts. These contracts cover grade separation bridges, storm drains, sanitary sewers, grading and paving, safety lighting and signing, and landscaping. These 17 contracts are as follows:

Description	*Contractor*	*Resident engineer*	*Estimated construction cost*
Eight-lane Freeway, Los Angeles Street to Grand Avenue	Webb & White	R. A. Collins	$1,050,000
Hill Street Relocation, from Sunset Boulevard to Temple Street	Webb & White	R. A. Collins	235,000
Hill Street Overcrossing	Spencer-Webb	C. J. Verner	495,000
Roadside Planting, Grand Avenue to Beaudry Avenue	Jannoch Nurseries	R. A. Collins	55,000
Roadside Planting, Beaudry Avenue to Virgil Avenue	Jannoch Nurseries	R. A. Collins	60,000
Eight-lane Freeway, Virgil Avenue to Western Avenue	Griffith Co.	John Ritter	1,719,000
Lighting and Signs, Virgil Avenue to Western Avenue	Fischbach & Moore	Ray De Groff	70,000
Pumping Plant and Storm Drains near Santa Monica Boulevard	J. E. Haddock	John Ritter	145,000
Fountain Avenue Overcrossing	Oberg Const. Co.	C. B. Ousted	360,000
Wilton Place Overcrossing	Geo. W. Peterson	W. B. Jomes	350,000
Sunset Boulevard Overcrossing	Lars Oberg	J. M. Peterson	343,000
Van Ness Ramp Bridges	J. E. Haddock	L. E. Crayne	358,000
Hollywood Boulevard Overcrossing	Frederickson & Kasler	Oscar Johnson	385,000
Grading, Paving and Five Bridges between Gower Street and Cahuenga Blvd.	Winston Bros. Company	C. J. Woodbridge	1,800,000
At Bronson Avenue and at Gower Street, Two Bridges, Storm Drain System and Sanitary Sewer System	Geo. W. Peterson and Jack W. Baker	I. W. Black	1,005,000
Holly Drive Undercrossing	Geo. W. Peterson and Jack W. Baker	F. M. Morrill	335,000
Cahuenga Boulevard Overcrossing	Oberg Bros.	Jack Sylvester	325,000
		Total	$9,090,000

Relocate Facilities

In addition to the above construction contracts, the Division of Highways has entered into service agreements with public utilities to relocate and reconstruct their existing facilities that are interfered with by freeway construction. Active work is now in progress on this reconstruction by the Pacific Telephone and Telegraph Company and the Los Angeles City Bureau of Water and Power. Extensive reconstruction work of pipe lines is also under way by the Southern California Gas Company. The final moving or demolition of buildings is now in progress to clear the last of the right-of-way areas so that final contracts to complete the grading and paving and other necessary construction between Western Avenue and Highland Avenue can be advertised very soon.

The Hollywood Freeway has been referred to as the "backbone" of the Los Angeles Metropolitan Freeway System. It is a part of U. S. Highway 101, which through the Los Angeles Civic Center is called the "Santa Ana Freeway" from the center line of Spring Street easterly, while from this point westerly it has been given the glamorous title of "Hollywood Freeway."

Construction now in progress on the section of U. S. Highway 101 from Los Angeles Street to Grand Avenue,

Looking west toward Western Avenue crossing, showing final roadbed preparation for pouring operations

for grading and paving under the previously constructed overcrossing grade separation bridges, was started January 31, 1951, by the contractors, Webb and White. From Broadway to Grand Avenue the excavation cuts averaging 50 feet in depth were brought down with $1\frac{1}{2}:1$ side slopes. From Los Angeles Street to Broadway the main freeway roadways are being enclosed by counter-fort type reinforced concrete retaining walls 30 feet high. Outside of these walls will be built outer highways connecting with the existing city streets. By previous contracts overcrossing structures were built on Hill Street, Broadway, Spring Street, Main Street and Los Angeles Street. Under these former contracts the roadway under the bridges was excavated to about six feet above final grade. There remained between Los Angeles Street and Grand Avenue 467,000 cubic yards of roadway excavation to be removed to complete the grading work. To date this has been 90 percent removed. The reinforced concrete retaining walls and the bridge over the Spring Street outlet ramp, comprising 4,600 cubic yards of structural concrete, are now 30 percent complete and are progressing rapidly.

Storm Drain Work

Storm drains and appurtenant catch-basins and junction structures are complete from Broadway to Spring Street. This is about 20 percent of the total storm drain work. It was foreseen that

This photograph shows one roadway poured and second in preparation at Vermont Avenue crossing

View looking easterly along Hollywood Freeway from above the four-level grade separation structure, showing grading contract work in progress through Los Angeles Civic Center area between Grand Avenue and Alameda Street

—Courtesy Pacific Air Industries

spring water flows would be encountered in the excavations, therefore, the main storm drains and laterals were laid with open joints and backfilled with filter material. In addition, between Broadway and Spring Street, at 50-foot intervals, six-inch perforated metal pipes were laid in diagonal trenches across the freeway, and were encased in filter material. By this means the water flowing in the sand strata imprisoned in the shale was effectively tapped and a dry, firm subgrade has been obtained.

Since the excavation work started on Fort Moore Hill over two years ago treasure hunters with imaginations fired by the exploits of the conquistadores have been eagerly haunting the construction area between Broadway and Grand Avenue. The power shovels have exposed bones and coffins at the site of the old French Cemetery, and bottles and utensils bearing marks of antiquity, but, alack and alas, no gold.

Outlet Ramps

Outlet ramps will transfer traffic eastbound from the freeway to Grand Avenue, Broadway, Spring Street, Main Street and Los Angeles Street; and westbound traffic to Spring Street. Inlet ramps to the freeway will provide access for traffic from Alameda Street, Los Angeles Street, Broadway and Grand Avenue. The contract is now 38 percent complete. It is expected that this section of the freeway will be completed by December 15, 1951.

As previously reported in the January-February, 1951, issue of *California Highways and Public Works*, traffic is now utilizing the top of the four-level grade separation interchange structure and moving over the completed portion of the Hollywood Freeway between Grand Avenue and Virgil Avenue. Westerly from Virgil Avenue the 1¾-mile section to Western Avenue is now being paved by Griffith Company and completion of this contract is expected by October 15, 1951.

Griffith Contract

The Griffith Company contract continues the same general type of eight-lane freeway construction as the completed section just easterly. The pavement on the freeway is Portland cement concrete, eight inches in thickness. This is placed upon an eight-inch layer of disintegrated granite, the top four inches of which is treated with 3½ percent Portland cement. This layer in turn is placed upon an eight-inch thickness of selected subbase material of relatively high bearing value. The source of the disintegrated granite is a location on Los Angeles City-owned land where it can be obtained free of royalty cost. The subbase material came from Fort Moore Hill excavation that had previously been selected and stockpiled for this purpose. Thus high quality material to provide suitable foundation for the Portland cement concrete pavement, making the total structural design 24 inches in thickness to support the modern heavy traffic loads, was obtained at a much lower cost than if all of this material had had to be obtained from commercial sources.

The Griffith Company contract also is providing for a large amount of storm drain system construction. This portion of the freeway intercepts large amounts of storm water flow originating in the Hollywood hills and flowing in the existing street gutters and storm drains. One of the special storm drain installations provides a 13-foot x

Paving machines in operation. Pouring and finishing work east of Western Avenue.

Aerial view looking northwesterly along Hollywood Freeway with Los Angeles Civic Center buildings in foreground
—Courtesy Pacific Air Industries

13-foot culvert and another provides a 69-inch diameter reinforced concrete pipe inverted siphon. Many other reinforced concrete culverts and pipes are necessary to complete the storm drain system.

Outer Highways

This contract also includes considerable lengths of outer highways on both sides of the freeway in order to connect existing city streets that would otherwise be dead-end. The contract includes a pedestrian underpass located between Kingsley Drive and Ardmore Avenue. This structure is necessary for the convenience of pedestrians in order to supplement grade separations at Normandie Avenue and at Santa Monica Boulevard, completed under other prior contracts which are already in service. In order to make the full length of the Griffith contract available for the use of public traffic immediately upon completion, temporary ramp connections are being provided at Western Avenue. These temporary ramps will enable public

Aerial view of Hollywood Freeway, looking southeasterly and taken from above Western Avenue, showing in the foreground work under construction between Western Avenue and Virgil Avenue, with completed portion of freeway in background

—Courtesy Pacific Air Industries

traffic to enter and leave the freeway at this location and to have the full use of completed Hollywood Freeway, a distance of 4.5 miles, between Western Avenue and Grand Avenue. Later in the year, when the Webb and White contract is completed through the Los Angeles Civic Center, traffic will then be able to travel on the freeway an additional one-half mile and turn on and off as desired at various locations in the civic center.

The budget for the 1951-52 Fiscal Year includes funds so that subsequent construction contracts can be advertised and let to complete the Hollywood Freeway. The construction schedule calls for a completion of the Hollywood Freeway throughout its entire length, from the Los Angeles Civic Center to Vineland Avenue, a distance of 10 miles, by the end of 1953.

Modern Expressway

Replaces Section of Deficient Highway in Riverside County

By CLYDE HIPPENSTIEL, Junior Civil Engineer

A MAJOR BOTTLENECK on U. S. 70-99, the last remaining link of rural two-lane highway between Los Angeles and the Palm Springs junction 90 miles to the east, was eliminated by the completion on May 21, 1951, of a 9.6-mile stretch of four-lane divided expressway between Redlands and Beaumont in Riverside County. The $1,240,000 project, jointly financed from state and federal aid funds, was constructed by the Sacramento firm of Fredericksen and Kasler.

Even before the "Old Spanish Trail" became the first overland trade route into California during the 1830's, the Spanish and Mexican peoples had endeavored to find a trail which could be traveled with reasonable safety between Sonora and California. The Yuma Indian massacres of the 1780's had caused the abandonment of the Anza Trail established by Juan Bautista de Anza, Spanish conqueror, who led an expedition from Sonora to Monterey in the year 1774, to establish a traversable land route. The Anza route when reopened in the 1820's was shifted to enter the San Bernardino Valley via the San Gorgonio pass which provided a much easier route than the rugged mountain crossings farther south.

Arguello Finds New Route

This portion of the trail leading through Banning and Beaumont remained in use until the year 1824 or 1825, when Santiago Arguello, on a punitive expedition to catch some Indian horse thieves, found the Indian trail up San Felipe Creek, past Borrego Valley, and up to the mountain plateau, at what is now Warner's Hot Springs. It was the San Felipe gateway that was to become the important southern gateway, the one used by Stephen Kearny, the Mormon battalion, and the Butterfield stages of later years.

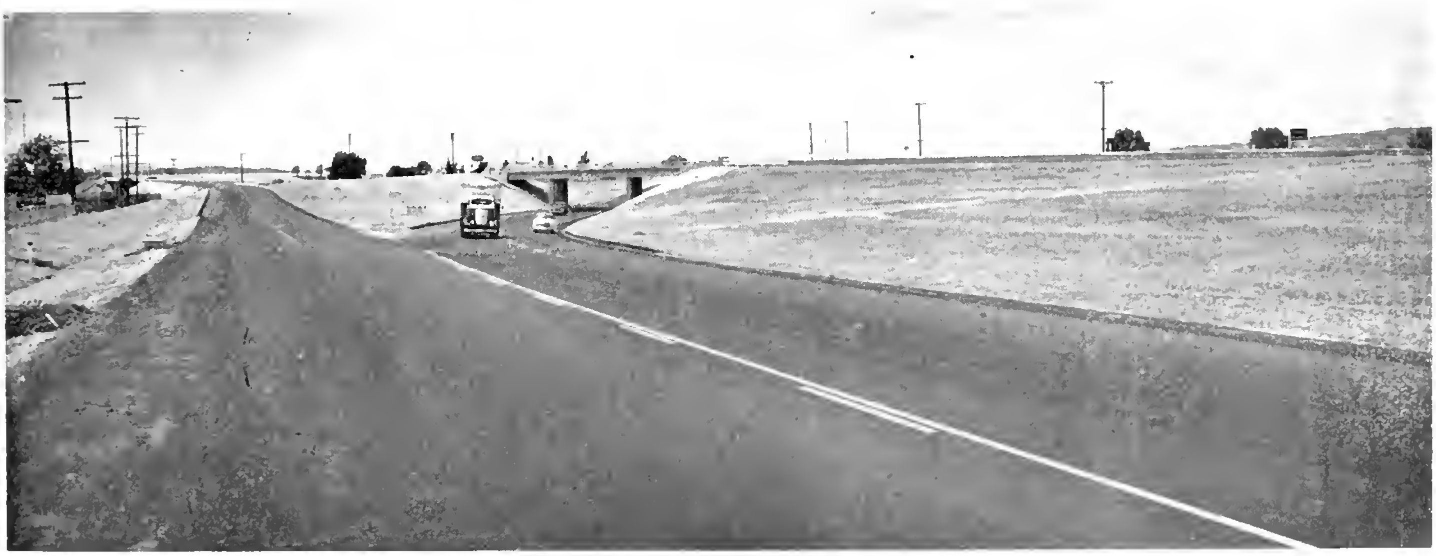
The newly completed section of expressway follows a course basically the same as that traversed by a portion of the Monterey-Sonora Road, the upper branch of the old "Emigrant Trail" from early California history. This branch of the Emigrant Trail, established in the 1820's, came from Warner's Ranch via Aguanga and passed down the San Jacinto Valley and across the hills to the site of what is now Beaumont. From there it continued northwest and west along the approximate course of the existing U. S. 70-99 through Redlands and old San Bernardino, or Guachama, to what is now Colton.

Two Major Gateways

U. S. 60-70-99 and San Gorgonio Pass, immediately east of this new section of expressway, form one of the two major gateways to coastal Southern California from the east, the other being U. S. 66 through Cajon Pass. At the westerly city limits of Beaumont, U. S. 60 and U. S. 70-99 divide the heavy load of interstate and local traffic bound for the metropolitan Los Angeles area, the former via Riverside and the latter by way of Redlands.

Of local interest, the completion of the four-laning of U. S. 70-99 will alleviate the conditions created by the extremely heavy truck traffic between the coastal cities and the fertile Imperial and Coachella Valleys. This, coupled with the transcontinental busses and trucks, eastern tourists, and

Undercrossing looking west from eastbound roadway at intersection of US 60 and US 70-99



Looking west of westerly intersection to Calimesa

the bulky recreational traffic headed for desert resorts in the Palm Springs area, caused a constant delay and congestion on the narrow, up and down highway.

Changes in Alignment

For the most part the existing highway was utilized as one roadway in the construction of the expressway. A face-lifting operation was performed on the old roadway in the form of resurfacing portions of the existing pavement, flattening the eroded roadside cut slopes, and seeding them with a mixture of alfalfa, barley and rye grass

This view is looking east through Calimesa after highway modernization

to conform to the slopes on the adjoining new construction.

Two major changes in alignment were effected in the construction of the new expressway. At the San Bernardino-Riverside county line, the old highway passed through a section of roadside business establishments in the small farm community of Calimesa. The constant delay, caused by local traffic plus the steep grade and unsatisfactory alignment of Calimesa Hill, immediately west of the business district, have been eliminated by skirting the community to the west. Channelized intersections east and west of Calimesa provide convenient access to and from the expressway.

The other major change in alignment was the construction of a grade separation structure and interchange at the "Y" junction with U. S. 60 near the west city limits of Beaumont. The intersection, formerly channelized at grade, had outlived its usefulness by reason of increased traffic volumes.

Looking east one-fourth mile east of Calimesa turnoff

Separation Structure

The only solution to this problem, a grade separation providing an interchange between the two highways, was denied for many years by the lack of funds. However, the increase in state gas tax in recent years made the improvement possible. The newly constructed separation structure now permits a free flow of opposing streams of traffic and should entirely eliminate accidents at the intersection of the two heavily traveled routes. To complete the remodeling, frontage roads were provided for properties fronting on the intersection with ingress and egress to the expressway at a safe distance from the interchange.

The right of way for this project involved the acquisition of 118 parcels, which included both land and access rights. Since the major portion of the construction consisted of widening existing facilities, in many cases the limitation of access along existing right of way lines was the only negotiation necessary. That portion of the project by-passing Calimesa required the purchase of land and access rights on new alignment.

Right of Way Work

Properties involved consisted of irrigated farm land, residential, light industry, motels, trailer courts, and commercial properties. In many cases where development was located within the new right of way, the existing improvements were disposed of at public auction.

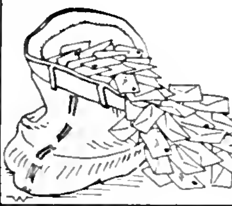
Another phase of right of way work necessary for the construction of the expressway was the relocation of high tension power line facilities, various telephone lines, gas lines, and privately owned irrigation systems. One very important utility facility affected was the coaxial cable owned by the Pacific Telephone and Telegraph Company. Construction of the expressway necessitated lowering and protection of the cable on a major portion of the project so as not to interfere with construction operations. This was accomplished by capping the cable with a concrete slab in all locations where the cable was less than five feet below the roadway grade. This and other work was performed by the utility company without any interruption in service. Consistent with the emphasis placed on safety in the design of the expressway, all cable manholes were removed from the pavement and improved shoulder areas. This was accomplished by constructing tunnels up to 20 feet in length from the cable to the relocated manhole. Further off-shoulder parking areas for cable maintenance equipment were constructed, as a safety measure.

The total cost for additional lands required, including limitation of access and utility relocation, was approximately $450,000. A single parcel, which involved access rights only, was acquired by condemnation proceedings. Three additional parcels were acquired by stipulated judgment without proceeding to actual trial, and all the remaining parcels were acquired by negotiations.

E. A. Bannister was Resident Engineer, assisted by F. M. Morrill, as Bridge Department Representative, on the construction of the expressway. G. D. Gardner is representing the State during the installation of the highway lighting and sign bridge under separate contract.

RIGHT OF WAY

It's a dangerous practice to debate the right of way on the highway. A better habit is to GIVE the right of way and debate it later. It may save your life.



Out of the Mail Bag

FROM A GEOLOGIST

UNIVERSITY OF OREGON
College of Liberal Arts

JANUARY 11, 1951

California Highways and Public Works
Post Office Box 1499
Sacramento, California

DEAR SIRS: I have seen your excellent magazine titled *California Highways and Public Works.* It has some excellent articles on engineering geology and as a geologist and traveler on California highways, I would appreciate being put on the mailing lists.

California seems to excel in daring when placing highways. The cuts are deeper, the fills larger than any that I have seen.

Sincerely yours,

(Signed) EWART M. BALDWIN
Associate Professor, Geology
Eugene, Oregon

USES MAGAZINE IN CLASSES

THE UNIVERSITY OF TENNESSEE
Knoxville
Department of Civil Engineering

JANUARY 9, 1951

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Post Office Box 1499
Sacramento, California

DEAR SIR: I should like very much to become a subscriber to *California Highways and Public Works.* I think it the best highway magazine that I see, as it has so many worthwhile articles as well as many interesting pictures. Since I teach the subject of highway location, survey and plans, I can always find some interesting material in your publication for my classes.

Very truly yours,

(Signed) R. T. BROWN
Associate Professor of Civil Engineering
Knoxville 16, Tenn.

KNOWS HIGHWAYS

Division of Highways
Post Office Box 1499
San Luis Obispo

GENTLEMEN: Having been directly interested in all California highways for a lifetime and for ten years as a Greyhound driver, I find your publication of a technical magazine very interesting to a layman. It always holds information of lasting interest to me and my passengers.

Would it be possible to put me on your mailing list?

I thank you.

JED S. BLAKE

WANTS OWN COPY

APRIL 30, 1951

California Highways and Public Works
Sacramento, California

GENTLEMEN: Your journal, *California Highways and Public Works,* is in files at the Union Oil Co. head office at Los Angeles. As a designer, I have made use of it many times.

I would like to have it sent to my residence, as my son (an engineering student at Berkeley), is also interested.

IRVING C. DODGE
10561 E. Olive St.,
Temple City

ENJOYS MAGAZINE

California Highways and Public Works
Post Office Box 1499
Sacramento, California

DEAR SIRS: To try to tell you how much I have enjoyed your publication *California Highways and Public Works* would be impossible. I have had the pleasure of reading it for many years, then passing it on to a friend.

Very truly yours,

J. A. BOYD,
1719 38th Ave.
San Francisco

In Memoriam

LESTER G. COREY

Friends and co-workers of Lester G. Corey in District VII, State Division of Highways, were saddened to learn of his death from a heart attack at his home, 2701 Birch Street, Alhambra, during the night of May 9, 1951, after 31 years of highway engineering service. He was a California native son, born in San Francisco on June 25, 1890, and residing in the Los Angeles area for the past 51 years.

Lester was a veteran of World War I, serving in the United States Army in the Philippines for a period of over three years. Upon receiving his honorable discharge from the Army in February, 1920, he took employment in District VII as a survey party chainman. He very quickly was promoted to field draftsman and instrumentman, working on extensive location and construction surveys until November, 1922. At that time he was transferred to construction and worked for two years as Assistant Resident Engineer on the first heavy grading operations for the Coast Highway along the ocean front south of Oxnard.

In March, 1924, Lester was promoted to Chief of Survey Party, a position which he held for 19 years. During these years he handled many important highway location and construction survey jobs throughout District VII.

Then Lester was transferred in September, 1943, to the District Office and for the last eight years of his engineering career worked on highway design problems. His broad engineering training and practical experience extending over so many years of survey and highway construction made him a very valuable addition to the engineering staff of the District Office. During the course of this assignment, he worked on special design features for the Hollywood Freeway, the Santa Ana Freeway and the Ramona Freeway.

He is survived by his widow, Mrs. Alma L. Corey, and by two brothers, Robert D. Corey of Huntington Park, and Ed L. Corey of San Gabriel. His many friends and associates extend their heartfelt sympathy to his family.

By-Pass Effects

Consistent Pattern Developed by Division of Highways Studies

By W. STANLEY YOUNG, Headquarters Right of Way Agent

The studies of the by-passes of the business districts of Folsom, Sacramento County, and Imperial, Imperial County, both having populations of approximately 1,700, have enabled us to compare the effects of circumventing a business district by several miles by means of a controlled access highway, to the effects on a similar-sized community where the by-pass is only one-half block removed from the former route down the main street.

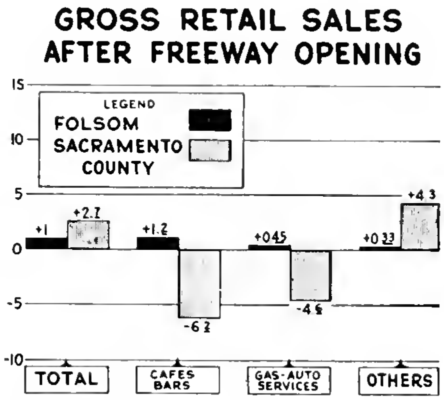
The consistent pattern developed in our previous by-pass studies indicated that it is relatively unimportant that local business be visible to highway travelers. The insignificant contribution from through traffic to business along a main street has been further delineated by the facts brought out in the first of the two most recently completed by-pass studies, which are discussed herein.

FOLSOM

The reason for building a controlled access by-pass of the City of Folsom, located 17 miles easterly of Sacramento, was for the purpose of providing a better highway alignment on this section of U. S. Highway 50. As a result of building the expressway along the most direct route practical, the highway now misses Folsom by several miles, and the distance between Sacramento and the Lake Tahoe resort area has been accordingly reduced by more than three miles.

As a consequence of the placing of the highway so far removed from Folsom, it is unlikely that an appreciable amount of recreational traffic now passes through the city.

Contrary to many expectations of the effect on the cafe, service station and bar business resulting from the almost total elimination of highway traffic, these businesses did not disclose any adverse effects. This is despite the fact that the Sunday and holiday traffic in Folsom was nearly halved. Weekday traffic remained about the same.



Weekday traffic along the new section of U. S. Highway 50 is approximately the same as the weekday traffic count within the City of Folsom since the by-pass, the number of vehicles per day being approximately 4,300.

Increase in Business Volume

In studying retail business of various types in Folsom over a period of years since the war, we found that the business volume of these establishments had not fluctuated so widely as had Sacramento County business volume, but rather had maintained a fairly constant, but slight, year to year increase in volume. This pattern continued during the year following opening of the freeway, when the 36 retail business establishments in Folsom showed an over-all increase of 1.0 percenr, while Sacramento County business gained 2.7 percent.

The local cafe and bar business increased 1.2 percent while Sacramento County cafes and bars declined 6.2 percent.

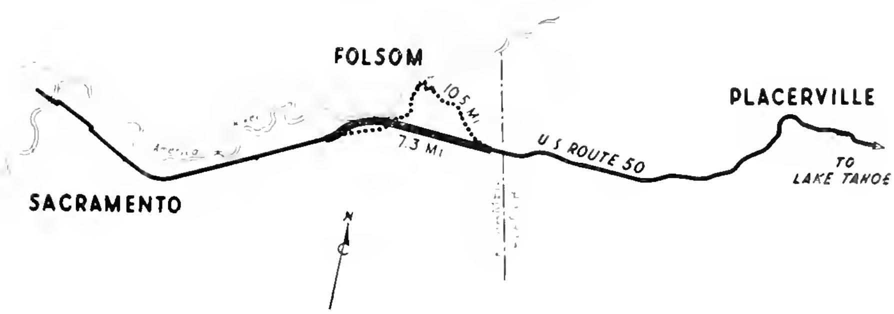
Folsom service stations increased 0.45 percent during the time that Sacramento County service stations decreased 4.6 percent.

Inasmuch as cafes, bars and service stations were almost the only businesses open on Sundays and holidays, and in a position to obtain a substantial amount of patronage from the heavy Sunday and holiday recreational traffic, the fact that these businesses did better than other types of retail outlets in Folsom establishes that the effect of through traffic removal was not detrimental. This is further brought out by the fact that Folsom cafes, bars and service stations had business increases, while county- and state-wide trends were downward.

Local Shoppers Not Discouraged

Contrary to the findings in our previous by-pass surveys, the classification "all other businesses" did not increase as much as did cafes, bars and service stations, which ordinarily enjoy a larger portion of business from highway through traffic. This indicates that traffic congestion had not reached the point where it was discouraging local shoppers who provide nearly all the patronage to these pedestrian-catering businesses. Businesses

Engineering diagram of U. S. Highway 50 between Sacramento and Placerville, showing the new expressway by-pass and the superseded route through Folsom



Downtown business scene in Folsom after opening of the by-pass, showing typical weekday parking and traffic conditions

such as clothing stores, groceries, varieties, etc., catering primarily to local patronage, disclosed an increase of .33 percent in business volume, while Sacramento County volume in these businesses increased 4.3 percent.

There were insufficient real estate transactions along the superseded highway in Folsom to produce any percentage figures but a general upward trend consistent with that section of the county was apparent. There were no signs of any decline in values of any Folsom properties resulting from the elimination of highway traffic.

IMPERIAL

While Folsom retail business did not register any actual monetary benefits from the through traffic removal, largely because no serious traffic condition existed along the main street during weekdays, the City of Imperial, located between El Centro and Brawley on U. S. Highway 99 in Imperial County, reflected slight benefits from the removal of the heavy produce truck and agricultural worker traffic.

Weekday traffic along the main street of Imperial was about 50 percent greater than that in Folsom. The fact that traffic volume was somewhat greater on weekdays than Sundays indicates the business and worker character of the through traffic, as distinguished from the heavy holiday use of the highway in the vicinity of Folsom which had placed only cafes, bars and service stations in Folsom in a position to secure a substantial amount of highway business. All types of business in Imperial had this opportunity, because of the uniform traffic count throughout the week.

RETAIL BUSINESS

Business volume throughout Imperial Valley, as well as in the City of Imperial, reflected the 24.33 percent decline in agricultural income during 1949 in the county. This was to be expected, inasmuch as practically the entire county economy is based on agriculture.

Imperial County over-all business volume dropped 6.8 percent. Meanwhile Imperial city business averaged a decline of 6.2 percent.

This downward trend was carried to the cafe and bar business in both Imperial and the county. County-wide businesses of this type declined 7.2 percent. Reflecting slight benefits from through traffic removal, Imperial cafes and bars declined only 6.7 percent.

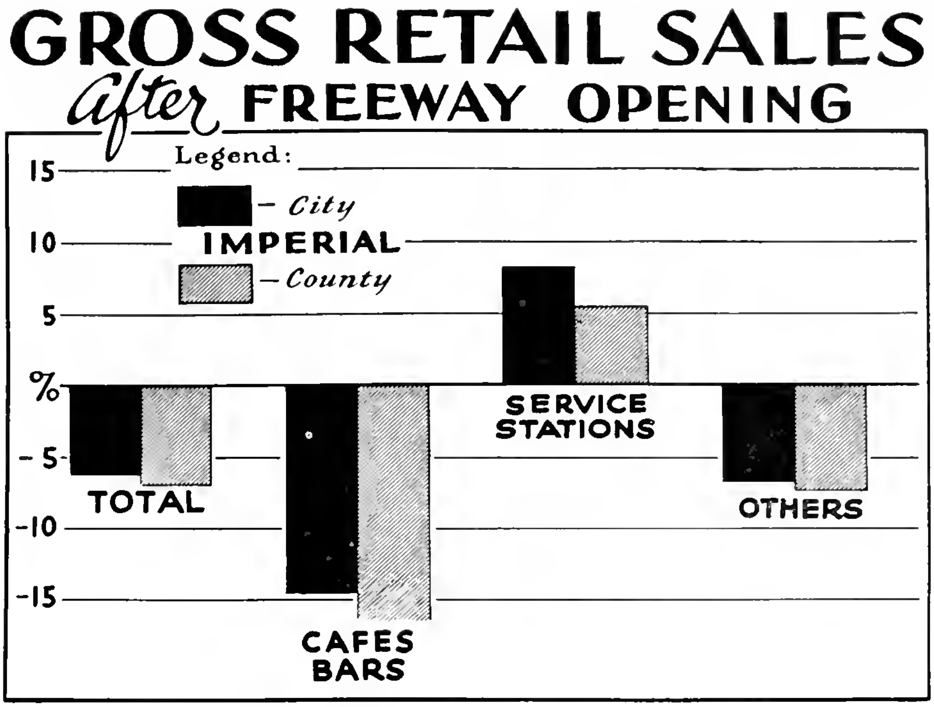
Failing to follow general economic conditions in the county, service stations enjoyed small gains in retail business volume. These establishments in the City of Imperial registered an 8.2 percent increase, while the Imperial County service station average was somewhat poorer, being a 5.3 percent increase. Gasoline gallonage in the City of Imperial declined 10 percent, however, while county-wide gallonage declined an unknown amount.

INDUSTRY

Although retail business was slightly improved after the alleviation of traffic congestion in Imperial, the principal benefits to the community, besides safety and convenience, were found in the stimulating effects of the highway improvement on light industrial development and expansion.

Soon after the expressway by-pass was opened to traffic, several new light industries sprang up on the east side of the highway opposite the main business district of the city. Included in these enterprises are a liquified gas concern, a sugar refinery, two masonry product plants, and a fertilizer distribution plant. In addition, the facilities of the Imperial Irrigation Company, largest valley industry, were considerably expanded.

The accompanying engineering diagram of the highway improvement through Imperial pictures the location of these new industries along the east side of the expressway opposite the main business district and also illustrates two methods commonly used by subdividers to obtain the maximum profits from their developments. The method of backing the first tier of lots up to the highway or by building a frontage road serving properties adjacent to the highway by the limiting of access, avoids the obsolescence of the highway facility in addition to preserving the advantages of highway proximity.



Highway Access Limited

The Division of Highways accomplished the same results in Imperial by buying the east tier of lots in the block east of the main street and building the expressway thereon. In this manner highway access was limited without disturbing the existing access rights of any abutting properties because the city street was left to serve as a frontage road for properties east of the expressway while properties immediately west of the expressway continued to be served as formerly—by the main business street.

The industrial plant developers in Imperial were quick to recognize the advantages of the frontage road—expressway arrangement which greatly extended the profitable economic life of their establishments.

Principally as a result of the industrial expansion on properties adjacent to the expressway, the value of building permits rose 29.2 percent in 1950, as compared to 1949. The properties on which these new establishments are located were previously vacant, largely unused, and had only conventional city street frontage.

The rapid expansion of previously undeveloped property along the new highway alignment, is further found in a comparison of assessed valuations in Imperial for the year 1950 to 1951. During the assessing year after opening of the expressway by-pass, assessed values within the city were raised $216,993. Since there was no deviation in the assessing rates of previously existing improved properties, this 20.2 percent increase over the preceding year, accurately reflects the actual business and residential growth, valuewise, in the City of Imperial. This growth is attributable principally to improvement of the highway facility.

POPULATION

An analysis and comparison of population trends in Imperial County and in the City of Imperial also indicate that construction of the expressway stimulated the growth of the city.

Imperial County population, which had remained static for several decades, showed an over-all increase of only 4.6 percent during the 10-year period between 1940 and 1950.

Percentage-wise, all of this population gain was absorbed by incorporated cities in the county and in addition enough rural residents moved to cities to register a total average city population increase of 13.1 percent. This resulted in a reduction of 6 percent in the number of people living in the county outside of cities.

Although the population of the City of Imperial followed average area trends through the war years, the city thereafter began to forge ahead of the average city gains throughout the county. Largely as a result of improvement of the highway and the light industrial development adjacent to the expressway, the number of residents in Imperial increased 3.2 percent above the average gain of all cities in the county between the years 1940 and 1950, or a total gain of 16.3 percent in 10 years.

Improvement of the highway apparently has also made this small city attractive to farmers, agricultural and other seasonal workers, because their radius of employment has been extended by the shortening of driving time and increased safety and convenience with which they can reach their places of employment.

FOLSOM AND IMPERIAL COMPARED

Although the population of these two cities is almost identical, and the principal economic support of both is from agriculture, the character of the through traffic formerly passing along

The main business street of Imperial subsequent to opening of the expressway by-pass, showing normal summer parking conditions

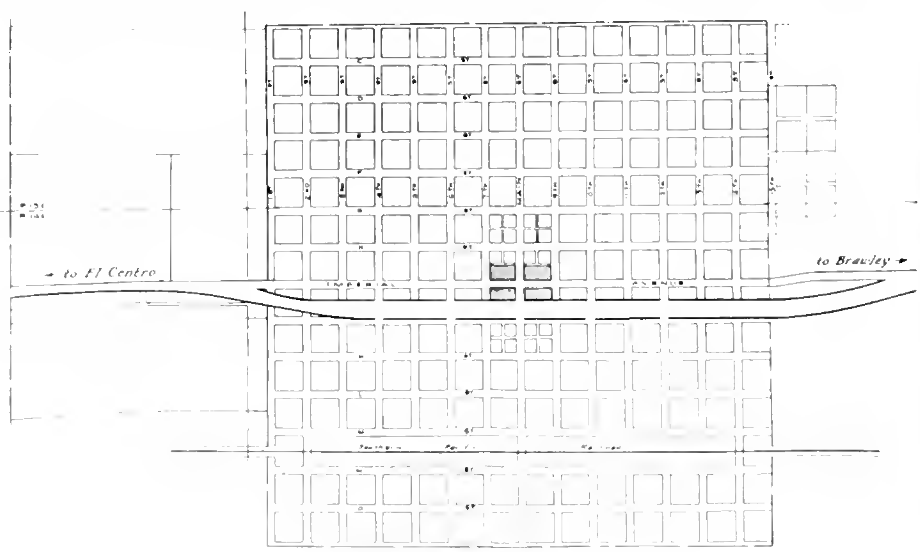
the main street highway in each location was considerably different. In the case of Folsom, the recreational nature of much of this through traffic was evident in the facts that Sunday and holiday traffic was nearly double that on weekdays and that weekday traffic did not drop off appreciably after the expressway opening. The year around resorts in the Lake Tahoe and other mountain areas have made U. S. 50 a very popular weekend vacation route for Northern California residents.

The business nature of the through traffic along Imperial's main street, previous to the construction of the expressway by-pass, was apparent in the very stable traffic count throughout the week, where the volume varied precisely with the amount of agricultural activity in the county. This traffic volume during the week was 50 percent greater than the average weekday vehicular traffic in Folsom, while Folsom's holiday traffic count was approximately 50 percent above Imperial's daily average.

The principal reason for the expressway by-pass in Folsom was the improvement of the highway alignment rather than to alleviate a congested condition. Congestion in Imperial and the slowing down of the large volume of through-traffic throughout the week necessitated the by-pass in this city.

While the by-pass of Folsom removed highway traffic several miles from the city, well outside of sight distance, and eliminated almost all of the through traffic trade, the by-pass of Imperial, only one-half block removed from the main business section, made it probable that most of the former highway patronage would continue

Engineering diagram of Imperial, showing the expressway by-pass of the main street. The shaded area represents the main business district. The location of the new industrial development in the city is east of the expressway along the city street, which now acts as a frontage road. The advertising value of highway frontage is thus coupled with safe and convenient property entrance from a lower speed local road.



IMPERIAL

Scene looking northerly towards Brawley, showing some of the new industries to the right of the expressway, opposite the Imperial business district

despite the by-pass. This was important to the cafes and service stations that cater to a considerable extent to truck drivers and packing plant representatives passing through the city.

CONCLUSIONS

It is apparent in our analysis of the gross retail sales of the various classes of business in Folsom, that the through traffic contribution to the business volume of the various business classes was insignificant. Since the businesses such as service stations, cafes and bars showed increases above other retail businesses which had small chance of obtaining any of the heavy Sunday and holiday through traffic patronage, this fact is established. In the light of our previous studies, the fact that Folsom retail businesses other than cafes, bars and service stations showed only slight gains indicates that traffic congestion was no serious problem in the city.

The retail busines volume analysis of Imperial businesses of all types, indicates that there was a slight increase in patronage following opening of the expressway, as compared to the county-wide average. Since the entire county had been very uniform in economic trends, these county figures provided an accurate measure of the by-pass effects on business.

No Detrimental Effects

Careful analysis of building permits issued, assessed valuation increases, and population figures in Imperial has pointed out some of the frequently less obvious benefits which may be realized by a small highway city as a result of improving the highway facilities in the vicinity.

It is significant that neither of these two smallest of the by-passed cities yet studied by the Division of Highways, has shown any detrimental effects on business or property values resulting from the highway improvement, despite the fact that in the case of Folsom almost all through traffic was totally eliminated.

As a result of the thorough study of all the facts available pertaining to these two locations, the apparent importance of highway patronage has diminished as compared to local customers, even in very small cities in California. This has been partially because of the changing habits of highway travelers to take advantage of the increased speed and safety of controlled access highways, and partly because the commonly held theory that "potential business volume is directly proportional to highway traffic volume" has proved to be erroneous.

From the analyses of the by-pass effects on the small cities of Folsom and Imperial and from the previously published analyses of by-pass effects on the Cities of North Sacramento, Auburn and Fairfield, has evolved the premise that "where existing through-traffic volume justifies a business district by-pass, retail businesses generally are financially benefited."

PEDESTRIAN SAFETY CONTEST

San Francisco and Burlingame have again been adjudged safe cities for pedestrians. In their population groups, San Francisco tied with Washington, D.C., for third place and Burlingame won honorable mention in the 1950 nation-wide Pedestrian Protection Contest conducted by the American Automobile Association and its affiliated clubs.

A year ago, San Francisco was first among cities in the 500,000 to 1,000,000 population group and won the grand award.

Burlingame took honors in the contest for the third consecutive year. In 1949, Burlingame won second place in its population group, and in 1948 was awarded a special citation.

PEDESTRIAN INJURIES

Two-thirds of all persons hurt in city traffic mishaps are on foot. Don't be a casualty of careless walking—look both ways before crossing streets.

Report on Progress and Records in Pavement Construction During 1950

By CARL ALZUETA, Assistant Engineer, Construction Department

During the year 1950 on our paving contracts there was not only a marked increase in the daily output of paving mixtures, but also a noticeable improvement in pavement riding qualities. With the return of normal working conditions after World War II and before the effects of the present crisis were materially felt, excellent paving records were made on state highway projects. From 1941-45, the demands of the war effort on trained construction personnel together with unavailability of new construction equipment resulted in decreased rates of production and lower quality of work.

Revisions are being made in the standards of design with respect to required thickness of surfacing and base materials. An attempt is being made to correlate more closely the supporting capacity of the basement soils and magnitude and number of individual wheel loads with the type and thickness of base and surfacing. The revised design procedure should largely eliminate the costly inequalities of over and under designing.

The roughness index, as mentioned in this article, is obtained by means of the roughometer, an instrument used by Headquarters Construction Department for some time to evaluate pavement roughness. The instrument is mounted on a passenger car and is actuated by vertical movements of the front axle as the car is driven over the road. Roughness is measured by summarizing on counters these vertical movements.

CEMENT TREATMENTS

Due to increasing wheel loads in both magnitude and number, on the highway system, the trend has been toward strengthening the bases by various types of cement treatments. The types of treatments vary in cement content and are for three distinct purposes as follows:

(1) The use of 4-7 percent cement in the construction of base courses under bituminous pavements to furnish a suitable and economical foundation with the object of obtaining a limited slab strength greater than the natural material but less than that of concrete pavement.

(2) The use of 1-2 percent cement to strengthen local materials for base courses under bituminous pavements and make importation of expensive higher quality rock bases unnecessary.

(3) The use of 3-5 percent cement to harden the subgrade under concrete pavements in soils that may soften and erode under rocking of the slabs.

PAVEMENT PROGRESS

Year	PCC PAVEMENT Class "B" Concrete — Average C.Y./day	Aver. Comp. Strength PSI †	Aver. Roughness Index inches/mile	PMS Aver. Roughness Index inches/mile	RMS Aver. Roughness Index inches/mile	BST Aver. Roughness Index inches/mile
1940	374	4204	7.4	23.1	49.2	
1941	460	3840	7.8	19.3	29.4	
1942	367	3690	8.0	14.6	25.5	
1943	337	3588	14.2	18.8	23.4	
1944	426	3876	10.3	16.8	32.9	
1945	236	4101	14.2	19.5	31.2	
1945-1949 *						
1950	662	3520	6.3	11.2	23.1	24.6

* No records were compiled in this period.
† 28 day breaks.

As an aid to materials control on construction, testing equipment formerly available only in Headquarters Laboratory was placed in the districts to expedite reporting of test data.

PORTLAND CEMENT CONCRETE

Automatic proportioning has become a specification requirement for all major jobs and the use of 34 E dual drum pavers is almost universal with the contractors. With the permissible 20 percent overload now provided for in the specifications, these traveling mixers can mix a 1½ cubic yard batch. Average daily production of pavement concrete for 1950 has been materially increased over any past year in which records were kept. Average daily production in the past year reached 662 cubic yards which is better than 200 cubic yards per day higher than the previously recorded high attained in 1941.

Present practice on transverse joints calls for the elimination of expansion joints except at bridge abutments and the placing of weakened plane joints at 15-foot intervals. Forming strips at the weakened plane joints remain in the concrete pavement and are finished over without edging. This procedure has resulted in improved riding qualities for this type of pavement.

The average roughness index for 41 miles of Portland cement concrete pavement completed under nine contracts during 1950 was 6.3 inches per mile. This value is considerably lower than any other value obtained since 1940.

Portland cement concrete pavement on the Hollywood Freeway in Los Angeles

Air entraining agents have not been specified as admixtures to pavement concrete since California's pavements are generally not subjected to alternate freezing and thawing. In addition, the properties of air entrained concrete do not lend themselves to the California method of delayed pavement finishing.

The highest average daily production of pavement concrete was accomplished on Contract 0-6VC35-F, Route 4 between 1 mile south of Tipton and the Tulare Airport. N. M. Ball Sons was the Contractor and C. F. Oliphant and J. T. Landers, resident engineer and street inspector, respectively. The exceptionally high average daily output of 1,040 cubic yards was attained.

The highest average compressive strength was obtained on the Parish Bros. Contract 1-10TC53-F on Route 7 through the American Canyon with an average 28 day strength of 4,315 psi. E. L. Craun was resident engineer, and M. B. Rowan, street inspector.

The average compressive strength for the State was 3,520 psi which is the lowest recorded value since 1940. This lower figure may well reflect the present emphasis on workability rather than on strength.

The record for riding quality was achieved on Contract 1-10TC54-F, Route 4 between Turlock and Keyes with an average roughness index of 5.2 inches per mile. United Concrete Pipe Corp. was the Contractor, W. L. Hurd, resident engineer, J. Schook, street inspector.

Plantmixed surfacing on US 101 near San Luis Obispo

Roadmixed surfacing near Salt Wells in San Bernardino County

BITUMINOUS PLANT-MIXED SURFACING

Plant-mixed surfacing continued as the predominating surfacing and was used on 72 percent of the bituminous treated mileage completed under contract in 1950. During the year a total of 338 miles was laid, both on resurfacing projects and on new construction.

The tendency towards the use of low penetration asphalts for plant-mixed surfacing is becoming more pronounced from year to year. Present practice is to provide various grades of paving asphalts in the specifications and to permit the engineer to designate the grade which will best suit the conditions at the time of the paving operations.

Continuous mixers are being used in greater numbers on State contracts involving plant-mixed surfacing but the conventional batch plant remains as the principal type of equipment. Despite their limited use, 7 of the 13 contracts exceeding 950 tons average daily output used continuous mixers.

The 1950 record for quality of riding surface on bituminous plant-mixed surfacing was shared by two projects:

Contract 1-4TC86-F, Route 5, between Greenville and 1.5 miles west of Livermore, Harms Bros. and N. M. Ball, Contractors, J. F. O'Brien, resident engineer.

Contract 1-7VC141-F,* Santa Ana Parkway, between Rosecrans Ave. and Orange county line, Peter Kiewit Sons, Contractor and B. N. Frykland, resident engineer.

Each contract had a roughness index of 6.4 inches per mile.

The average for the State was 11.2 inches per mile as compared to the previous low of 14.6 inches per mile in 1942.

* Contract 1-7VC141-F contained both asphaltic concrete and plant-mixed surfacing.

ASPHALTIC CONCRETE SURFACING

Asphaltic concrete, once a major type of surfacing, was used on only 2 percent of the asphaltic type surfaces. Present day asphalt concrete is laid without the use of side forms with self propelled mechanical spreading and finishing equipment.

ROAD-MIXED SURFACING

The total mileage of road-mixed surfacing constructed under contracts completed during 1950 was 95 miles which was 22 percent of the total bituminous surfacing placed by the State.

The road-mixed method of bituminous construction, while not requiring the oil, moisture, or aggregate gradation control of the plant-mixed method, does have a place in the construction of low cost highways in remote regions. It continues to be an economical type of pavement construction in the desert regions where drying conditions are suitable and in remote areas for small jobs that do not warrant a plant set-up.

Prevalence of road-mixing in the desert regions is illustrated by the fact

that 79 percent of all road-mix mileage laid in 1950 was done in Districts IX and XI.

The record for road-mixed surfacing smoothness was on Contract 1-11VC59, Route 187 between Holtville and Calipatria. The contractor was Arthur A. Johnson and the resident engineer was W. L. Cattell. The roughness index was 13.4 inches per mile. Average roughness for the year was 23.1 inches per mile which compares favorably with the previous low of 23.4 inches in 1943.

BITUMINOUS SURFACE TREATMENT

No attempt was made to compare the riding characteristics of bituminous surface treatments. This surfacing calls for treatment of the existing materials and there are no specifications for the mineral aggregate. Since it is obvious that the riding qualities of the surfacing are partly dependent on the aggregate grading, and that the contractor and engineer cannot obtain a riding quality higher than that inherently in the aggregate, it would be unfair to compare all such projects on an equal basis.

PORTLAND CONCRETE CEMENT PAVEMENT

Location	Contractor	Resident Engineer	Street Man	Average cu. yds. placed per day	Average strength, 28 days, lbs. per sq. inch	Roughness index, inches per mile
Eastshore Freeway, south city limits Oakland—16 miles south High Street	Frederickson & Watson Const. Co.	J. F. O'Brien	E. Carlstad & J. W. Vickrey, Jr.	651	3735	5.8
Route 5, Greenville—1.5 miles west Livermore	Harms Bros. & N. M. Ball Sons	G. L. Beckwith	L. Marshall	755	3495	5.7
Route 2, .2 mile east Ventura County Line—.2 mile east Carpinteria	Granite Const. Company	J. C. Adams	C. L. Bunce	358	3563	7.3
Route 4, 1 mile south Tipton—Tulare Airport	N. M. Ball Sons	C. F. Oliphant	J. T. Landers	1040	2622	6.9
Bakersfield, Golden State Ave., 23st-H St., north Garces Circle	Griffith Co.	W. M. Nett	O. R. Adams	691	3270	5.8
Rosemead Blvd., Beverly Blvd.—Garvey Avenue	J. E. Haddock, Ltd.	F. A. Read	R. H. Butler	559	3325	6.7
Route 4, Mariposa Road south of Stockton—Calaveras River	United Concrete Pipe Corp.	F. Fleharty	R. K. Wells	540	3810	6.9
Route 7, .25 mile west of Napa County Line—Cordelia Underpass	Parish Bros.	E. L. Craun	M. B. Rowan	814	4315	6.2
Route 4, Turlock-Keyes	United Concrete Pipe Corp.	W. L. Hurd	J. Schook	551	3630	5.2
			Average	662	3520	6.3 *

* Weighted average

ROAD-MIXED SURFACING

Location	Contractor	Resident Engineer	Roughness Index Inches per Mile
Rte. 48, Maple Creek—1.2 miles easterly	A. R. McEwen	A. J. Braga	28.1
Rte. 89, 5.4 miles—6.0 miles north of Middletown	Arthur B. Sin, Inc.	C. Morrison	55.5
Quincy High School line change	Steele and Easton	J. L. Fonseca	37.8
Rte. 57, 4 miles east of Cuyama Maintenance Station—3 miles west of SLO county line	Rand Const. Co.	M. A. Dawson	19.2
Lovers Lane, State Rte. 134—6 miles north	George France	W. C. Clark	13.8
Rte. 41, Kingsburg Canal (near Centerville)	Fred F. Braun	R. Windele	55.0
Rte. 57, 6 miles west—2 miles west of San Emidio Road	Rand Const. Co.	W. M. Nett	21.3
Rte. 127, Soda Plant—8 miles south	R. A. Erwin	F. N. Roberts	21.7
Rte. 23, Little Lake—3 miles north	Halloran & Gill	M. D. Tetrick	17.4
Rte. 111, 1 mile north of Grant Lake—Junction Rte. 23	Westbrook and Pope	W. E. Kip	18.5
Rte. 145, Searles Road—Rademacher	E. C. Young and Co.	R. M. Kelly	26.8
Rte. 23, Aberdeen and Black Rock Curves	E. C. Young and Co.	R. W. Fisher	17.8
Rte. 95, Rte. 23—Topaz	Harms Bros.	G. J. Snyder	31.4
Rte. 212, Kern county line—5.5 miles east of Salt Wells	Oilfields Trucking Co. and Phoenix Const. Co.	F. E. Thompson	23.2
Rte. 187, At Sandia and Alamorio Turns	E. C. Young and Co.	W. L. Cattell	22.2
Rte. 202, Ash Canal—South Alamo Canal	Hubbs Equipment Co.	W. L. Cattell	14.7
Rte. 27, Midway Wells—Colorado River	E. S. and N. S. Johnson	W. R. Connelly	18.0
Rte. 187, Holtville—Calipatria	Arthur A. Johnson	W. L. Cattell	13.4
Rte. 64, Indio—Black Butte	R. P. Shea Co.	W. L. Cattell	23.6
		Weighted Average	23.1

BITUMINOUS PLANT-MIXED SURFACING

Location	Contractor	Resident Engineer	Tons per Day	Roughness Index Inches per Mile	Remarks
Rte. 1, Klamath River Bridge—Wilson Creek	Harms Bros. & C. M. Syar	E. J. Reed	608	6.7	
Rte. 1, 1 mile south of Orick—2 miles south of Del Norte county line	Mercer Fraser Co., Mercer Fraser Gas Co.	R. L. Meyers	516	7.6	
Rte. 1, 5 miles south of Stone Lagoon Summit—1 mile south of Orick	Mercer Fraser Co., Mercer Fraser Gas Co.	H. M. Hansen	515	8.3	
Rte. 3, Anderson—Clear Creek	Frederickson and Watson Const. Co.	W. Z. Hegy	428	6.8	
Rte. 28, Chambers Ranch—Alturas	Clements Co.	W. H. Bartlett	810	10.6	
Rte. 7, Southerly District Boundary—Proberta	McGillivray Const. Co.	R. J. Wilson	1080	8.4	3000# Stationary Batch Plant
2 miles east of Chico—Paradise	A. G. Raisch Co.	E. H. Wyman	725	11.0	
Rte. 87, Tudor Road—Lincoln Road	Rice Bros.	G. B. Sherman	503	8.8	
Rte. 37, 1 mile east of Auburn—1 mile west of Applegate	Frederickson Bros.	F. D. Hillebrand	848	10.7	
Rte. 6, south half Yolo Causeway	Brighton Sand and Gravel	H. A. Towne	438	8.6	
Rte. 87, Marysville—Butte County line (various locations)	Rice Bros.	M. Chapman	295	15.3	
Rte. 87, Sutter Causeway about 12 miles north Knights Landing	Rice Bros.	G. B. Sherman	350	10.6	
Rte. 5, Greenville—1.5 miles west of Livermore	Harms Bros. & N. M. Ball Sons	J. F. O'Brien	419	6.4	
Rte. 1, Ignacio—Richardson Bay Bridge	A. G. Raisch Co.	C. W. Schemel	550	12.2	
Rte. 42, .3 mile south Saratoga Ave.—1 mile south (near Saratoga)	Dan Caputo & E. A. Keeble	R. J. Norris	442	11.0	
Rte. 107, at Rosewarns under-crossing 1.5 mile east of Niles	Elmer J. Warner	L. G. Marshall	323	10.8	
Rte. 8 and 49, Foster Road—Union Station	Frederickson Bros.	E. J. Carter	601	9.9	
Rte. 56, Frenchman's Creek—1 mile north (near Half Moon)	Eugene G. Alves	W. G. Remington	397	24.5	
Rte. 2, Gilroy—2-6 miles south of Gilroy	Frederickson & Watson Const. Co.	R. J. Norris	735	10.0	
Rte. 2, 3.3 miles south of San Jose—Madrone (Various locations)	Leo. Piazza	E. W. Strandberg	739	12.3	
Avila Road, Ontario Hot Springs—Avila	Granite Const. Co.	H. J. Holman	515	9.6	
Rte. 2—Gonzales—Chualar	Rice Bros.	M. A. Dawson	716	10.5	
Rte. 2, Spence underpass—2 miles south of Salinas	Rice Bros.	J. M. Sturgeon	598	11.3	
Rte. 2, 6 miles east of Arroyo Quemado—.7 miles west of Arroyo Hondo	Clyde W. Wood	G. T. McCoy, Jr.	409	10.5	
Rte. 2, Cuesta Siding—1 mile south of Santa Margarita	Granite Const. Co.	V. E. Pearson	519	10.0	
Rte. 56, San Julian Road, Jalama Road—Rte 149	Rand Const. Co.	M. A. Dawson	565	11.6	
Rte. 2, Orcutt Wye—Santa Maria	Madonna Const. Co.	A. L. Lamb	1005	10.5	Continuous Mixer
Rte. 2, 2 miles east of Ventura County line—.2 miles east of Carpinteria	Granite Const. Co.	J. C. Adams	475	9.3	
Rte. 33, Rte. 125—Kern County line	Granite Const. Co.	W. J. Pairine	539	11.9	
Brundage Lane, Union Ave.—Fairfax Road	Oilfields Trucking Co. and Phoenix Const. Co.	J. W. Cole	495	9.5	
Madera Ave., Church Ave.—Adams Ave.	Gene Richards Inc.	H. R. Langworthy	770	13.1	
Rte. 4, 1 mile south Tipton—Tulare Airport	N. M. Ball Sons	C. F. Oliphant	438	9.7	
Rte. 10, Visalia—Venida Substation	Griffith Co.	C. F. Oliphant	1290	9.1	Continuous Mixer
Rte. 4, San Fernando Blvd.—Burbank Blvd.	Griffith Co.	R. M. Cooley	514	10.6	Asphaltic Concrete
Rte. 2, near El Rio and Oxnard	Griffith Co.	M. F. Masters	664	12.2	Asphaltic Concrete
Rte. 60, Washington Blvd.—Venice Blvd.	Jesse S. Smith and A. A. Edmondson	L. E. Steele	496	16.3	

BITUMINOUS PLANT-MIXED SURFACING—Continued

Location	Contractor	Resident Engineer	Tons per Day	Roughness Index Inches per Mile	Remarks
Firestone Blvd., Lakewood Blvd.—Rosecrans Ave.	Basich Bros. Const. Co. and Basich Bros.	A. W. Carr	960	14.5	Continuous Mixer
E. Foothill Blvd. and Mountain Ave.—Shamrock Ave. and Huntington Drive	Vido Kovacevich Co.	D. J. Faulkner	841	11.5	
Rte. 213, Pacoima Creek—Saure Ave.	Vido Kovacevich Co.	F. E. Sturgeon	945	10.2	Asphaltic Concrete
Grand Ave., Artesia Ave.—A. T. & S. F. underpass	Cox Bros.	C. J. McCullough		25.6	Production rate not available
Anaheim-Telegraph Road, Hoefner Ave.—A. T. & S. F. underpass	Griffith Co.	C. E. Dresser	577	10.7	
Santa Ana Parkway, Rosecrans Ave.—Orange County line	Peter Kiewit Sons Co.	B. N. Frykland	990	6.4	Continuous Mixer A. C. and P. M. S.
Oxnard Blvd., north city limits—south city limits (Oxnard)	Baker and Pollack	M. F. Masters	642	12.5	Asphaltic Concrete
Rte. 60, south city limits (Newport Beach)—Myrtle Ave (Laguna Beach)	Hensley Const. Corp.	L. W. Sixt	1005	14.5	Continuous Mixer
Huntington Beach Blvd., Garfield Ave.—23d St.	Sully-Miller Const. Co.	C. J. McCullough	1150	9.3	4000# Stationary Batch Plant
Sepulveda Blvd., Sunset—Ventura Blvd.	Schroeder and Co.	H. F. Meinke	636	15.5	
N. Figueroa St., Marmion Way—Ave. 50	C. O. Sparks, Inc. and Mundo Engr. Co.	R. A. Collins	750	16.8	
Rte. 2, east city limits—San Jon Road (city Ventura)	Griffith Co.	M. F. Masters	834	15.8	
Rte. 164, Imperial Hwy.—Century Blvd.	Oswald Bros. Co.	F. A. Reed	615	12.3	
Sepulveda Blvd., Ohio Ave.—Bolas St.	Jesse S. Smith	H. F. Memke	974	18.5	3000# Stationary Batch Plant
Firestone Blvd., Central Ave.—Ivy St.	C. O. Sparks Inc. and Mundo Engr. Co.	R. A. Collins	600	8.7	
San Clemente, Mile 1.77—Mile 3.89	Sully-Miller Const. Co.	L. W. Sixt	832	14.1	
S. Figueroa St., Lomita Blvd.—I St.	Warren Southwest, Inc.	D. J. Faulkner	925	14.5	
Olympic Blvd., Lemon St.—Boyle Ave.	Griffith Co.	R. A. Collins	1540	19.2	11 hrs. per day 4000# Stationary Batch Plant
Pacific Coast Highway, A. T. & S. F. overhead—Figueroa St.	Griffith Co.	D. J. Faulkner	750	16.0	
Foothill Blvd., Sierra Madre Villa Ave.—Michillinda Ave.	J. E. Haddock	D. J. Faulkner	900	12.3	
Rte. 207, Long Point—1.3 miles west of Running Springs	Fredericksen and Kasler	E. A. Bannister	923	9.3	
Rte. 43, Russell St.—.3 mile north San Bernardino County line (city Riverside)	J. A. Payton	W. H. Crawford	719	7.8	
Rte. 77 and 192, 3.6 miles west Corona and Pine Ave. about 7.5 miles south of Ontario	A. Teichert and Son, Inc.	K. B. Stone	471	10.1	
Rte. 190, E. St.—east city limits (city San Bernardino)	George Herz	W. Ford	723	10.3	
Rte. 31, Manix—Cronise Lake	Basich Bros. Const. Co. and R. L. and N. L. Basich	H. C. Prentice	1181	9.7	Continuous Mixer
Rte. 26, San Antonio Ave.—Corona St. (city Ontario)	George Herz	L. M. Barnett	1280	13.8	2 Plants Used
Highland Ave., 1 mile west Riverside Ave.—1 mile west of Cajon Creek	R. A. Erwin	S. J. Smith	432	10.3	
Rte. 190, north city limits—Rte. 26 and Orange St.—east city limits (city Redlands)	George Herz	L. B. Barnett	680	9.7	
Rte. 192, 3 mile south of south city limits—Dessau St. (city Ontario)	Cox Bros.	K. B. Stone	565	8.1	
Rte. 23, Conway Summit—Bodie Road	Harms Bros.	W. R. Coons	688	12.0	
Rte. 23, Los Angeles County line—Freeman junction (portions)	G. W. Ellis	F. N. Roberts	685	15.1	

BITUMINOUS PLANT-MIXED SURFACING—Continued

Location	Contractor	Resident Engineer	Tons per Day	Roughness Index Inches per Mile	Remarks
Los Banos—Pipe Line Road	Covina Const. Co.	H. Jantzen	663	11.3	
Thornton Road, Benson Ferry Bridge—.8 mile southeasterly	M. J. B. Const. Co.	C. Plecarpo	275	18.2	
Grant Line Road, State Rte. 5 northwest of Tracy-Holly Sugar Spur	P. J. Moore and Son	C. Plecarpo	727	13.5	
Vander-Vacaville and Vacaville-Elmira	Frederickson Bros.	R. Dixon	420	31.2	
Wilson Way, East Charter Way—north city limits (city Stockton)	A. Teichert and Son	R. K. Wells	826	14.1	
Rte. 13, Junction Rte. 109—1 mile east of Oakdale	Munn and Perkins	M. B. Rowan	435	8.5	
Rte. 32, 10.4 miles east Los Banos—San Joaquin River (portions)	Valley Paving and Const. Co.	H. Jantzen	831	10.8	
Rte. 7, Junction county road to Vacaville—2.5 miles north (portions)	Frederickson Bros.	E. L. Craun	714	7.5	
Rte. 53, 4 miles east of Terminous	Claude C. Wood	F. Fleharty	315	11.2	
Rte. 18, 1.7 miles west of Mariposa County line—Cathay Junction	Rice Bros.	F. Fleharty	747	8.7	
Rte. 77, Miramar—Lake Hodges	Peter Kiewit Sons	G. L. Richardson	1483	12.3	Continuous Mixer
Rte. 2, Del Mar—San Onofre (portions)	Griffith Co.	J. A. Jesperson	1150	11.9	4000# Stationary Batch Plant
Rte. 2, 16th St.—7th St. Channel (National City)	R. E. Hazard Const. Co.	W. T. Rhodes	500	14.4	
Pacific Highway, Counts St.—Rosecrans St. (city San Diego)	Cox Bros.	L. G. Cline	392	70.6	
			Weighted Average	11.2	

LETTER FROM RIVERSIDE

COUNTY OF RIVERSIDE

June 4, 1951

Mr. G. T. McCoy,
State Highway Engineer
Division of Highways
Sacramento 7, California

Dear Sir: The contractor will this week complete the bridge over the Whitewater River at Thermal.

The completion of this bridge will be a worthy and needed addition to the improvements on this county's federal aid system.

The assistance given this office by your staff—both Mr. Sweet and others in the Sacramento office, and Mr. Green and his staff in the Los Angeles office—is greatly appreciated.

May we also thank you for the courteous treatment accorded Mr. Powell in connection with the proposed bridge over the Santa Ana River on Crestmore Road during his recent visit to Sacramento.

Very truly yours,

A. C. Keith
County Surveyor and Road Commissioner

Highway Dodgerettes Seek Championship

Highway Dodgerettes—FRONT ROW, LEFT TO RIGHT: Shirley Hicks, Mary Bush, Arleen Scott, Clarene Hean, Salley Jaime, Agnes Raker. REAR ROW, LEFT TO RIGHT: Paul Wulff (Manager), Ann Pratt (Coach), Shirley Meredith, Esther George, Hazel Blair, Velora Meredith, and Corinne Dolce.

The Highway Dodgerettes, sponsored by the Public Works Athletic Association and managed by Paul Wulff, are begining their second season in the Girls Night City Soft Ball League. Ann Pratt is the coach.

They were the winners of the 1950 Sacramento City Championship in B Division. This enabled the team to get its uniforms and equipment for this year.

To date the Dodgerettes have had one tie game with Anglo Bank—score 8 to 8. The girls are all out to win the 1951 championship.

Bayshore Freeway

Continued from page 4 . . .

to be built between these two cities, and it will require another $50,000,000 to complete it to modern freeway standards.

"A major undertaking—financially comparable to your magnificent Bay Bridge—a necessary undertaking! Upon this highway traffic builds up from over 11,000 vehicles per day just north of San Jose to more than 60,000 per day at this section, which is near the ultimate San Francisco terminus. The estimated 1970 comparable figures are 20,000 and 105,000 vehicles per day.

"But vehicles per day are not the only evidence of importance of a route, nor the only justification for building freeways to modern standards, or spending these sums of money.

Accident Rates Important

"Accident rates are important and I am able to report to you that on freeways built during the last four years, the death rate on them is 73 percent less than the death rate reported for all our highways in the year 1949. To be more specific, in a major city of the southland, we have a freeway and an ordinary state highway carrying nearly comparable traffic, approximately 45,000 vehicles per day on each, with slightly more on the freeway. The accident rate per million motor vehicle miles on the highway is at the state-wide average; the rate on the freeway only one-sixth of that amount.

"Freeways in high traffic areas are not only desirable but highly necessary. I can assure you that your State Highway Commission is concerned with this problem, and that this state route, a portion of which is completed for use today, will be constructed to freeway standards as rapidly as possible consistent with the needs, requirements and fairness to other parts of California.

"But let us not be too optimistic about getting this and the other freeways of California completed at an early date.

"Apparently we have been making progress, substantial progress, in the freeway program, not only here but throughout the State of California. But, in fact, we are still losing in the struggle to catch up with the growing demands, the necessary requirements of present-day highway traffic.

"California is still a growing State in every respect except land area. The greatest migration the world has ever known is damming up here on the Pacific Coast. We now have more than 10,500,000 people within our boundaries, and more than 5,100,000 motor vehicles registered for use. More vehicles than any other state in the Union,

. . . Continued on page 41

OCEANSIDE APPRECIATES HIGHWAY SIGN

UPPER—Oceanside directional sign visibility in daylight
LOWER—Visibility at sunset

Appreciation of the action of the Division of Highways in placing a directional sign at the intersection of State Route 195 and US 395, directing traffic to Oceanside in San Diego County, has been received by Director of Public Works C. H. Purcell from Arthur L. Strong, Chairman of the Highway Committee of the Oceanside Chamber of Commerce.

"The Oceanside Chamber of Commerce," Strong wrote, "requested that a suitable sign directing traffic to Oceanside be erected at the intersection of State Route 195 and US 395. We were given the sign without cost and are very grateful for it and the recognition of the importance of State Route 195.

"We are enclosing a couple of photographs of the Oceanside sign, one taken at 3 p.m. and one at late twilight. We feel that these pictures tell the story better than we could tell it with words."

No Damages

San Diego Jury Supports the State in Freeway Litigation

By JAMES R. SMITH, Right of Way Agent

A NOTEWORTHY ADDITION to the volume of actual records indicating the beneficial effects of freeway construction on the value of abutting properties is a recent San Diego court case.

The property involved is located on the southeast corner of 10th Avenue and Ash Street in San Diego. Ash Street was made a primary approach road to the Cabrillo Freeway, while 10th Avenue became a one-way artery, delivering freeway traffic into the downtown street system. The construction of the highway improvement transformed a little used park road and its feeders into high volume arteries fusing traffic from U. S. 80 and 395 and directing it into the main business area.

Southeast corner of 10th and Ash Streets in San Diego before construction. Stucco apartment building visible at extreme right. Ash Street approach to Cabrillo Freeway in left foreground.

In the fall of 1948, after unsuccessful attempts at negotiation, the property owner requested court action to determine the damages to his property by the State's taking of the access rights along Ash Street.

The defendant's witnesses during the course of the trial testified that the taking of access rights had the effect of changing the character of the property from a corner lot to an inside lot, the resulting difference between the two representing a diminution in value, ranging from \$3,800 to \$6,000.

State's Contentions

In light of the subsequent development, it is interesting to review the contentions made by the State prior to the acquisition, and concurred in by the impartial expert witnesses employed by the State at the trial, that the taking of access rights along the north side would have no adverse effect on the development of the lot for its highest and best use, which was for apartment house purposes, because entrance ways could be best developed on the 10th Avenue frontage, that the property after the taking would still retain all the valuable attributes of the corner lot, such as light, air, and view, and in addition the property would enjoy special benefits to the extent of \$2,500 through increased prominence and advertising value due to the construction of Ash Street as an integral part of the freeway.

Southeast corner of 10th and Ash Streets after construction. Motel is fronting on 10th Street.

The jury indicated its concurrence in the opinion of the State's witnesses by arriving at a verdict of no damages and special benefits of \$2,500.

Property Value Increases

The subsequent development of the property is graphically portrayed in the accompanying before and after photographs. The degree to which the entire holding was developed to its highest and best use and the rapidity

with which this was accomplished after the freeway had been constructed, is indicative of the enhancement by highway improvement.

The subject property with its two old single family residences was purchased in 1948, prior to the freeway construction, for $17,500 by the owner of the adjoining lot. The improvement on this adjoining lot consisted of a two-story stucco apartment building.

annual net income of $3,600 to the owner, the equivalent of a 5 percent return on a $72,000 investment because the lessee pays all expenses, including taxes and public utilities, and no management is necessary on the part of the owner.

The property prior to execution of the Travelodge lease indicated a capitalized value of $48,000, based on a 5 percent return on a net income of

This after-construction photograph shows south end of motel

In the fall of 1950, the owner entered into a 49-year lease with the nationally known Travelodge Corporation for the two lots. The corporation immediately demolished the three old buildings and has since constructed in their place, without cost to the owner, the present modern apartment-motel, containing 15 hotel rooms and 18 bachelor apartments with kitchenettes, shown in the accompanying photograph.

Revealing Figures

The lease provides for a monthly rental to the owner of $300. This is an

$200 per month, after subtractions for costs of management, taxes, insurance, depreciation, maintenance, utilities, and incidental operating expenses from the prior average gross income.

The present indicated value of $72,000 is secured by a $242,000 building which guarantees beyond a doubt the payment of the $300 monthly rental for the 49-year term of the lease. By adding the value of the building at the termination of the lease, an amount in excess of the $72,000 is indicated as the present value of the property, which is a 50 percent increase in the two years following completion of the freeway.

Charles H. Parker Retires to Enter Private Practice

Chas H. Parker, who established the first Hydraulics Department in the Division of Highways, in District VII in 1938, and who has headed, directed and instructed that department ever since, has retired after 23 years with District VII. He persistently advocated a concept of highway drainage based on the utilization of approach velocities, the application of Bernoulli's constant method of nonuniform flow design, and the doctrine that most culvert failures are the result of inlet ponding or outlet erosion.

"Chuck" had completed 38 years of engineering practice and had established and taught enough principles of storm water run-off to satisfy most men, but is determined to pursue his specialty as an avocation and will practice hydraulics, hydrology, and drainage as a consulting engineer.

Bayshore Freeway

Continued from page 39 . . .

more autos in relation to population than any other state or nation in the world, and still they come, crowding our highways with an additional 100,000 or 200,000 cars which individually stay but a short time, but collectively remain pretty much the same total throughout the year.

"This increase in population and vehicle registration, the increase in use per car per year that is taking place, have necessitated changes in design and planning—more traffic lanes—more structures—wider rights of way. Cost of construction per unit is also climbing—35 percent in the last year.

"The result—well, though we have spent or allocated more than $460,000,000 in the first five-year period, the unbudgeted critical deficiencies as of January 1, 1951, now total $3,000,000,000, with an income for rights of way and construction of approximately $100,000,000 per year. San Francisco's portion in this deficiency list amounts to $173,600,000 within her county boundaries. You may do your own calculating as to when this program will be completed.

"I say these things to you, not in advocacy of additional taxes or changed laws, but that you may know the facts, understand the problems of the State Highway Commission and be more charitable to and less demanding of us when we are unable immediately to solve your highway problems, untangle your traffic snarls, and reduce your accident rates as soon as we all would like to see these things accomplished. It all amounts to a Herculean task. Let us all cooperate to build a whole highway system carefully, thoughtfully, with full view not only of the present but also of the future. Let us all with patience join in building California as she should be built."

Sets Record

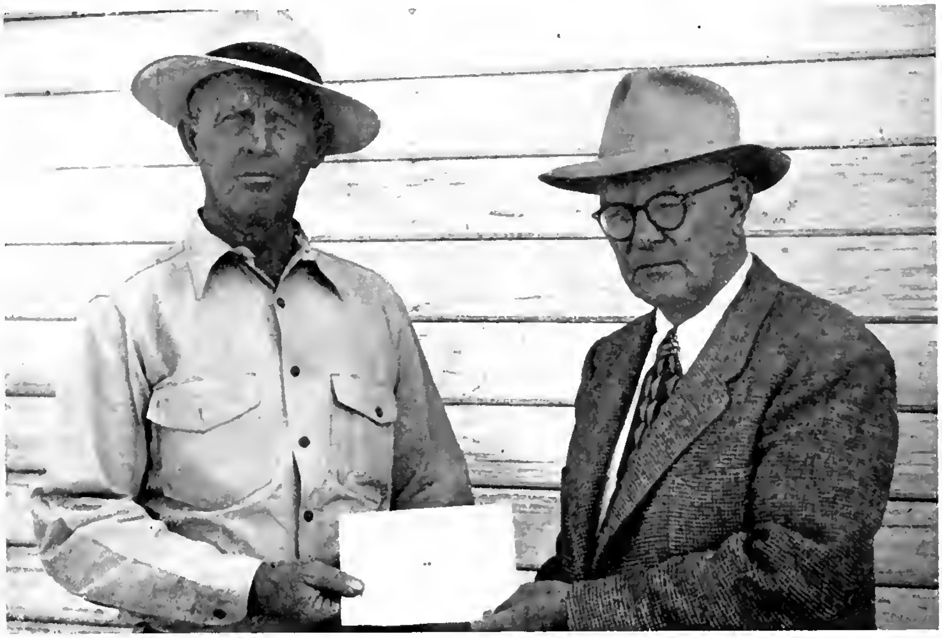
Highway Foreman on Job 30 Years Without Loss of Day Due to Accident

By J. H. BUCKLE, District Safety Supervisor

THIRTY YEARS without losing a day's work due to an accident!

That's the safety record of Foreman G. C. Brunk of District VI, Fresno. This is indeed a remarkable record when you consider that for years Brunk was stationed at Oak Glen on the Ridge Route south of Bakersfield where traffic always is heavy and snow conditions induce added hazards in the winter.

Mr. Brunk, however, is not the only safety-conscious employee in District VI. Ninety-six safety awards were made in this district for the year 1950, and it is not easy to get a safety award in District VI.



Foreman George C. Brunk, left, receiving from C. F. Waite, Assistant District Engineer, his Safety Certificate

Purcell Directive

District Engineer E. T. Scott, following the directive of State Highway Engineer C. H. Purcell in 1940 that a corrective safety program be inaugurated to reduce the high employee accident rate, outlined the basic principles for a district program:

1. That employee safety would be the responsibility of supervision at all levels in a manner similar to other aspects of work control.

2. That safety considerations would be given appropriate weight in efficiency reports of supervisors and employees alike.

3. That the basic weapon with which to attack the problems would be a district safety council.

4. That membership in the council should be restricted to employees in the lower brackets under the theory that men who suffer the accidents are in the best position to determine how to prevent them.

Competition Encouraged

5. That the basic ideas as to how to prevent specific types of accidents would originate in the field and the function of district office personnel would largely be to encourage and co-ordinate, supply basic facts from accident analysis, direct efforts into needed channels, evaluate ideas, attempt to put worthwhile suggestions into effect, disseminate information and otherwise assist the safety council in its constant search for preventive measures.

6. That competition between individuals and groups should be encouraged.

7. That maximum recognition would be given to individuals and organizational units for safety achievements.

8. That within the organization as wide publicity as possible be secured for all types of safety information so as to engender and maintain safety consciousness.

District Safety Council

The district safety council consists of a member from each maintenance superintendent's territory, a member from the Equipment Department, and field engineers from the Engineering Section. Since the council is to represent men in the field, councilmen from the grade of foreman or below are selected from and for the maintenance and shop crews. Field engineers are represented by a member below the rank of resident engineer. Councilmen are elected by the men in the territory which they represent. Offices are for one year and elections are staggered.

Council meetings are held about every six weeks. Not all of the members attend every meeting. Meetings are held in different locations in the district so that all the members have an opportunity to attend at one time or another.

Recommendations and suggestions made by the Council are presented to a district safety committee of administrative officers appointed by the district engineer. The district safety committee can take direct administrative action or refer questions for advice and decision to the division safety committee at headquarters in Sacramento.

Various Safety Awards

Chairman of the district committee is C. F. Waite, assistant district engineer. Serving on the district committee are F. F. Baxter, maintenance engineer; F. M. Roush, construction engineer; E. W. Taylor, traffic engineer; E. R. Bunker, right-of-way agent; and W. H. Riechel, shop superintendent. J. H. Buckle, safety supervisor, is secretary of the committee.

The district safety council issues safety awards for good safety records. Certificates, lapel pins and a trophy are used. All field employees are classified into two groups. Maintenance and shop employees below the grade of foreman are classified as being in "hazardous" occupations. Foremen and field engineers are in "semihazardous" occupations.

Employees in hazardous occupations must work five years without a lost-time accident to receive a second-class certificate. A gold seal is added for each additional year to 10 years. For 10 years without a lost-time accident, an employee receives a first-class certificate. Gold seals are then added yearly to the fifteenth year, at which time an employee is presented with a gold lapel pin.

Trophy Awarded Each Year

Employees in semihazardous occupations work eight years to receive a second-class certificate, thirteen years to be eligible to receive a first-class certificate and 20 years for a pin.

The trophy is awarded each year to the superintendent's maintenance crew which has the best acident record, the lowest frequency rate, for the year. If the crew holds the lowest frequency rate for three consecutive years, that crew keeps the trophy permanently. Two crews have permanent trophies. The Taft crew, under Maintenance Superintendent L. W. Seymour, and the Porterville crew, under Superintendent A. F. Jeffrey, have both maintained three years of record without a lost-time accident.

Gold seals, pins and trophies are financed by contributions from the district department heads and other supervising personnel. The State provides only the printed certificates.

District VI has the distinction of having made the lowest frequency rate, that of 13.22, for any year of the 10 years of Division of Highways' record. Three years the district held first place. Six times the district placed among the top three. Only twice has the district dropped below the yearly state-wide district frequency rate.

TRAFFIC ACCIDENT TOLL

An average of 33 American soldiers was killed daily in Korea during the first year of the war, while at home automobile deaths averaged 99 a day.

Venture Success

Continued from page 7 . . .

Ample Parking Space

The building averages 15,000 square feet and the location has parking facilities for about 138 cars, with additional space available for potential expansion. All of which—considering the magnitude of this venture—implies that Safeway expects the freeway to prove no barrier to business volume in the new super market.

Inquiry at the company's headquarters reveals that an extensive and impressive array of research is involved in the search for probable profitable sites for Safeway's new retail stores.

The company has maps made to order of all cities and towns in which Safeway operates. The maps are all to the same scale and contain such essential information as population, traffic, important civic buildings, zoning, etc.

"In some cases," explains a company spokesman, "we have special surveys made by our research department, and these may be to determine shopping habits within a specified area, or to establish the amount of foot and vehicular traffic passing a certain site. All in all, there's a great deal of factual study undertaken before a location is selected for a Safeway store. Thus, with the guesswork removed, the new store starts out with the odds in its favor provided our facts and figures and foresight are substantiated."

Experimental Venture

Regarding the reasons for selecting the site adjacent to the freeway in Vallejo, the company frankly admits:

"The problem of freeways is increasing and many business firms must face it sooner or later. We decided to face it in Vallejo in the hopes of finding some valuable answers."

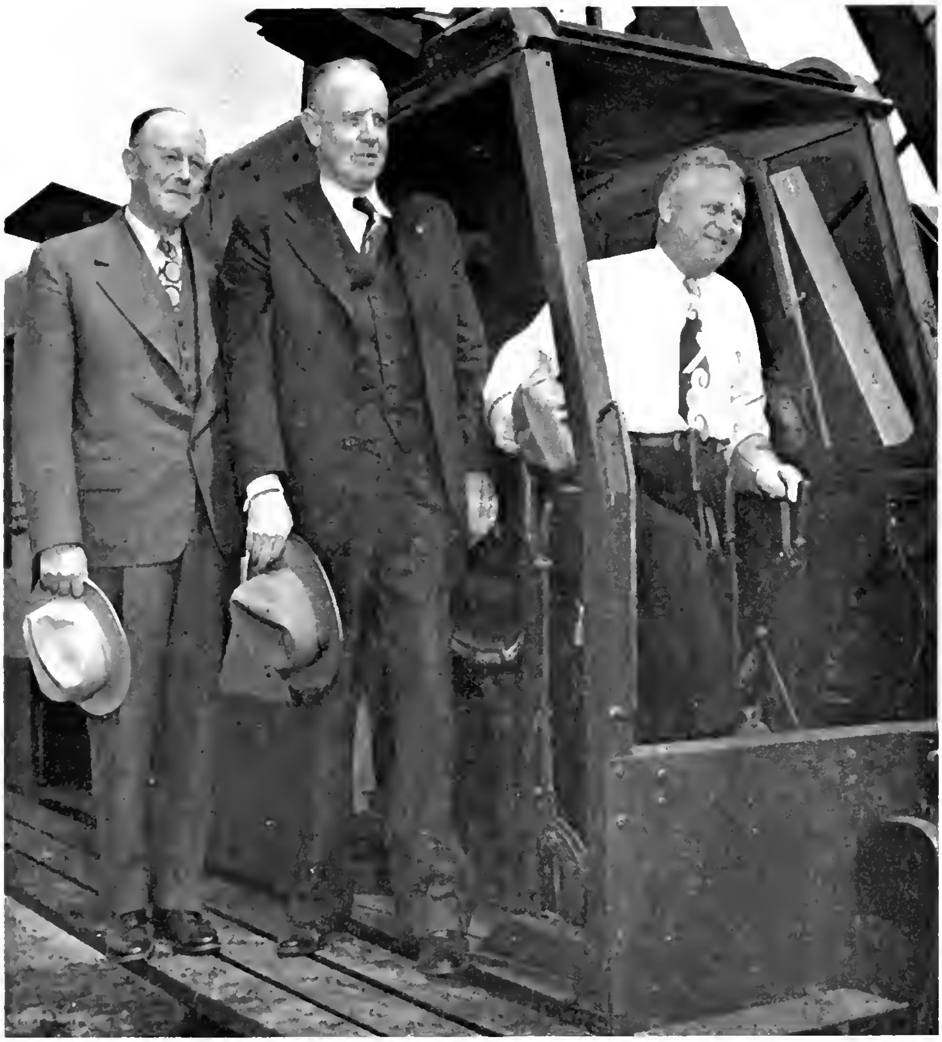
That the company is discovering some valuable answers to the question of freeways is evident since the Vallejo store opened for business recently.

This is a front view of the modern food store constructed by Safeway Stores, Inc., in Vallejo

While not wishing to reveal actual figures or submit to prophesying at this early date, Safeway sources hint that the volume in the new store is exceeding the fact-finders' estimates. Thus while a freeway may speed up traffic, it doesn't restrict the freedom of shoppers—and customers will continue to "beat a path to the door" of any business that has what the customers desire.

Another vital factor advanced by many firms located on off-roads paralleling freeways is added safety. Guests or patrons can park their cars on secondary highways in comparative

. . . Continued on page 49



Highway Commissioner Harrison R. Baker operates controls of huge shovel at Colorado Bridge ground-breaking ceremonies. On his right are Highway Commissioners Chester H. Warlow and Charles T. Leigh.

Ground Broken

Continued from page 6 . . .

projects have been larger, but the contract awards have been in smaller units. The entire cost of the project, including the bridge, right of way and the freeway approaches extending from Patrician Way on the west to Holly Street on the east, will be approximately $6,000,000.

Freeway Approaches

"The present Colorado Street Bridge, which was built in 1912-1914 to serve the traffic of that day when there were 35,000 registered motor vehicles in the County of Los Angeles, is a world famous and beautiful structure which has served its purpose well.

"It was designed by Waddell & Harrington, eminent bridge engineers, and built by Mercereau Bridge and Construction Co. at a total cost of approximately $200,000 for the structure and some $30,000 for right of way.

"Funds have been budgeted for the construction of the freeway approaches to the new bridge extending about three-fourths mile to Patrician Way on the west and to Holly Street on the east. The contracts for this construction will be let during the coming year so that the freeway approaches will be completed and placed in use concurrently with the bridge.

"As a symbol of the future it is our hope that this new bridge structure will be a part of a great freeway extending easterly and westerly to serve the traffic needs of the foothill area, probably to be known as the Colorado Parkway, and as such, to serve as another link in the chain of the great metropolitan freeway system so urgently required to serve the traffic needs of this populous Southern California area."

Highway Agencies Conduct Course in Photogrammetry

By SCOTT H. LATHROP
Assistant Engineer, Public Relations and Personnel

UNDER THE JOINT sponsorship of the California Division of Highways and the U. S. Bureau of Public Roads, a course on photogrammetry as applied to highway location was held in Sacramento from April 2d to April 13th. Of those receiving instruction, 23 were from the California Division of Highways, nine from the U. S. Bureau of Public Roads, three from the Arizona Highway Department and one from the California Division of Water Resources.

The instructor was William T. Pryor of the Washington office of the Bureau of Public Roads. Pryor is one of the outstanding authorities on the application of aerial surveying, or stereophotography, to highway location and has used these methods in locating highways in Alaska and Panama, as well as in many sections of this Country. At present he is engaged in applying the principles to the reconnaissance for the Mississippi Valley Parkway.

The first week of the course was devoted to lectures covering all phases of the subject, including early development of aerial surveying, the use of various available plotting machines and the theory and practice of photogrammetry as applied to the location of highways. Underlying theories were developed and their application to practical problems demonstrated by means of slides and photographs.

During the second week all the time was given to actual practice with aerial

photographs and stereoscopes. Instruction was given in applying the principles covered previously to the location of a section of highway from 10 to 20 miles long.

On Monday afternoon of the second week, an inspection trip through the topographic office of the U. S. Geological Survey was arranged for all the students. This office uses many of the methods and machines which were discussed by Pryor. Arrangements for the trip were made with Conrad Ecklund, and the details of the inspection were handled by D. H. Rutledge, both of whom are with the U. S. Geological Survey. The information gained on this trip was of great help in aiding the students to make practical application of the theoretical material which had been presented to them.

The engineers assigned to this course were well grounded in the theory and practice of highway location by the older conventional methods.

This study of photogrammetry is expected to result in more extensive use of the latest aerial techniques in highway location, with resultant savings in cost and more rapid completion of plans for future construction.

UPPER—Photogrammetry class at work on individual highway locations
LOWER—Instructor William Pryor, seated, demonstrates use of stereoscope

MOTORING RESPONSIBILITY

Owning and driving an automobile is a major responsibility. Behind the wheel of your car, you are concerned not only with your own safety, but with that of others. Take this responsibility seriously, and always drive carefully.

THIS FISH FOSSIL 15 MILLION YEARS OLD

Fish fossil found during excavation of old Fort Moore Hill in Los Angeles to make way for Hollywood Freeway

If you scratch the surface of a highway engineer, you often find underneath that he is a geologist, paleontologist or archeologist. Henry (Hank) Compagnon, a Supervisor of Survey Parties in District VII, Los Angeles, is no exception to this rule. During his off duty time on Amchitka Island in the Aleutians during World War II, Hank made exploratory excavations among ancient Indian kitchen middens and brought to light numerous skeletons, Indian relics, and artifacts. Many of his finds were turned over to the Smithsonian Institution and to the Los Angeles County Museum where they are now on exhibition.

When Hank came back from the war and resumed his civilian occupation with the State Division of Highways, one of the highway projects upon which he was responsible for the construction surveys was the Guy F. Atkinson Company's contract for excavation of old Fort Moore Hill in the City of Los Angeles, to make way for the Hollywood Freeway. This construction contract was first reported in *California Highways and Public Works* magazine in the issue of May-June, 1949. A concluding writeup regarding the completion of this contract appeared in the January-February, 1951, issue, with illustrative photographs of the work.

Find Fish Fossil

The record of the Fort Moore Hill excavation is not complete, however, without a story of the splendid and unique fish fossil found in the excavation by Hank Compagnon and Paul Wallace, Chief of Survey Party. A row of grade stakes was being surveyed near the site of the northerly abutment of the Broadway overcrossing bridge. The fish fossil, about 15 inches long, was found in a tilted clay strata about 75 feet below the original ground surface. Fossils of animal life or marine life which have tough bones or hard shells are very common, but well preserved fish fossils are rare indeed because when fishes die their soft bodies are usually consumed long before they are covered with sediment, and become fossilized. This particular fossil is very unusual in appearance because the percolating waters that replaced the bone tissue were of such a nature that the fossil has an opalized appearance, with the scales and bone structure of the fish giving off a gemlike sparkle.

15 Million Years Old

The fossil has been turned over to Dr. Hildegarde Howard, former Curator of Paleontology, now Chief Curator of Science, at the Los Angeles County Museum at Exposition Park. Dr. Howard has stated that the sedimentary deposit in which the fossil was found is of the Upper Miocene geological age and that it is estimated to be at least 15,000,000 years old. As fossils go, this is quite ancient because those found in the famous La Brea Pits at Hancock Park on Wilshire Boulevard in Los Angeles, are of the Upper Pleistocene age and are approximately 40,000 years old.

Dr. Howard says that very few fish fossils have been found in this area similar to the one found by Compagnon and Wallace, and that the only one of which she has knowledge was found in the Santa Monica Mountains about 35 miles away. So the fish fossil that District VII has turned over to the Los Angeles County Museum is the only one of its kind yet to be found in the City of Los Angeles, and it is interesting to note that this fossil was actually found in the Civic Center, even within the shadow of the City Hall Tower.

ALLERGIC TO LAWYERS

A citizen in Venice, California, has an abiding fear of attorneys who threaten to sue him. He admits as much in a letter to the legal division of the Department of Public Works. He wrote:

"I am writing in reference to Bill No. 7127-D7 for $20.93 which was incurred by tearing up one of the State's culverts with the underside of my automobile (hereafter to be referred to in the past tense). I should have contacted you when I received your first bill, but I am lazy, forgetful and irresponsible. This is not an excuse but an explanation. Now, however, I feel that I must meet my obligation to you. You have done the right thing. A threat of legal action always galvanizes me into frenzied financial activity.

"I truly wish that I could pay the whole amount immediately, thus taking the pressure off us both. But you are only one of many, so the best that I can offer is a promise of $2.93 in the next mail, with similar small amounts to follow as regularly and as often as my insufficient income will allow. Would two or three dollars a week be satisfactory?

"Yours, till the bill is paid."

HIGHWAY BIDS AND AWARDS

Highway Bids and Awards April, 1951

ALAMEDA COUNTY—Furnish and install a traffic signal system in City of Livermore at intersection of W. First Street and S. L Street. District IV, Route 108. Spott Electrical Co. of Hayward, Hayward, $3,575; L. H. Leonardi Electric Construction Co., San Rafael, $3,596; R. Goold and Son, Stockton, $4,100; Sam Elliott Electric, Livermore, $4,197; Ahbett Electric Corp., San Francisco, $4,283; Severin Electric Co., San Francisco, $4,470; Sloat-Hall Electric Co., Inc., Oakland, $4,484; Fields Electric Works, Santa Clara, $7,058. Contract awarded to Howard Electric Co., Gilroy, $2,986.

ALAMEDA COUNTY—Across San Leandro Bay, between Bay Farm Island and Alameda, in the City of Alameda, a bascule bridge to be constructed. District IV, Route 226. Ben C. Gerwick, Inc., San Francisco, $1,670,286; Healy Tibbitts Construction Co., San Francisco, $1,690,022; Guy F. Atkinson Co., South San Francisco, $1,707,588. Contract awarded to The Duncanson Harrelson Co. and Stolte, Inc., Richmond, $1,631,057.80.

ALAMEDA COUNTY—On Eastshore Highway, between Ashby Avenue and El Cerrito Overhead, about 2.4 miles to be surfaced with plant-mix surfacing over existing pavement. District IV, Route 69, Section Ber., Alb., Ransome Co., Emeryville, $115,-812; J. R. Armstrong, El Cerrito, $123,571; J. Henry Harris, Berkeley, $139,722. Contract awarded to Lee J. Immel, San Pablo, $105,423.30.

AMADOR COUNTY—At Dry Creek, about 5 miles north of Ione, a reinforced concrete "T" beam type of bridge, to be constructed, and about 0.5 mile of approaches to be graded and plant-mix surfacing placed on imported base material. District X, Route 97, Section B. Thomas Construction Co., Fresno, $74,207; Carey Brothers and Bailey, San Rafael, $75,987; B. S. McElderry and Chittenden and Chittenden, Auburn, $87,177; O'Connor Brothers, Red Bluff, $96,572; Johnson, Drake and Piper, Inc., Oakland, $97,406. Contract awarded to Lefever and Bing, Sacramento, $73,878.

BUTTE COUNTY—At Clear Creek, about 10 miles northwest of Oroville, a reinforced concrete slab bridge to be constructed and approaches to be surfaced with plant-mixed surfacing. District III, Route 87, Section B. Eugene G. Alves, Pittsburg, $51,266; Commercial Construction Co., Marysville, $51,-639; D. Gerald Bing, Sacramento, $55,369; O'Connor Brothers, Red Bluff, $59,937; B. S. McElderry and Chittenden and Chittenden, Auburn, $64,321; H. H. Anderson, San Leandro, $66,356; Piombo Construction Co., San Francisco, $71,726. Contract awarded to R. C. Downer, Reno, $47,713.50.

COLUSA COUNTY—Between Colusa and Meridian, about 6.9 miles to be widened and surfaced with plant-mixed surfacing on untreated rock base and existing pavement. District III, Route 15, Section B. Rice Brothers, Inc., Marysville, $154,819; H. Earl Parker, Inc., Marysville, $165,240. Contract awarded to Harms Brothers, Sacramento, $142,934.

DEL NORTE COUNTY—Between Smith River Bridge and one-fourth mile north of Winton Corners, about 4.7 miles to be surfaced with plant-mixed surfacing on cement treated base. District I, Route 71, Sections A, B. Clements and Co., Hayward, $263,-476; Harms Brothers and C. M. Syar, Sacramento, $264,163; Ball and Simpson, Berkeley, $302,963. Contract awarded to Mercer Fraser Co. and Mercer Fraser Gas Co., Inc., Eureka, $205,445.50.

DEL NORTE AND HUMBOLDT COUNTIES—Across Redwood Creek at Orick, and across Smith River, about 3.3 miles south of the town of Smith River, 2 existing steel bridges to be cleaned and painted. District I, Route 1, 71, Sections K, A. R. W. Reade and Co., Berkeley, $43,122. Contract awarded to Russell Hinton Co., San Francisco, $26,568.

HUMBOLDT COUNTY—Across South Fork Eel River 6 miles south of Garberville, across South Fork Eel River at Dyerville, across Eel River at Scotia, and across Eel River 1.8 miles north of Scotia, four existing steel bridges to be cleaned and painted. District I, Route 1, Sections A, C, E. Deemer and Deemer, San Francisco, $76,650; J. S. Morris Company, Berkeley, $98,800; R. W. Reade and Co., Berkeley, $124,777. Contract awarded to Russell Hinton Co., San Francisco, $50,781.

INYO COUNTY—Between Route 63 and 1.3 miles north and between the west city limits and Main Street in Bishop, about 1.8 miles to be surfaced with plant-mixed surfacing on cement treated base and drainage facilities to be constructed on Location 2. District IX, Route 23, 76, Sections C, Bis. Bailey Construction Co. and Bishop Engr. and Const. Co., Bishop, $97,481; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $109,757; Basich Brothers Construction Co. and R. L. Basich and N. L. Basich, Garvey, $115,212. Contract awarded to G. W. Ellis Construction Co., North Hollywood, $96,587.10.

INYO COUNTY—Between Division Creek and Aberdeen and between Keough Hot Springs and Steven's Corner, about 0.4 mile at Location 1 to be surfaced with road mixed surfacing and about 5.6 miles at Location 2, bituminous surface treatment applied to shoulders. District IX, Route 23, Sections B, D. Arthur A. Johnson, Laguna Beach, $28,-654; Bailey Construction Co. and Bishop Engr. and Const. Co., Bishop, $31,564; Anderson Co., Visalia, $32,370; Oilfields Trucking Co. and Phoenix Const. Co., Inc., Bakersfield, $34,574; L. B. Wells Const. Co., Visalia, $37,661. Contract awarded to Verne MacArthur, La Crescenta, $26,035.

KERN COUNTY—Between the junction Route 136 and the Tulare County line, about 1 mile to be resurfaced with plant-mixed surfacing and imported borrow placed. District VI, Route 4, Section Dln. Dicco, Inc., Bakersfield, $30,298. Contract awarded to Griffith Co., Los Angeles, $24,116.50.

KERN COUNTY—Between 4.4 miles east of Sivert and 2 miles west of Bear Mountain Ranch, about 7.1 miles, existing roadbed material to be cement treated and surfaced with plant-mixed surfacing. District VI, Route 58, Section D. Griffith Co., Los Angeles, $157,408; Basich Brothers Construction Co., N. L. Basich and R. L. Basich, Garvey, $190,947; Peter Kiewit Sons' Co., Arcadia, $193,-050; Dicco, Inc., Bakersfield, $198,607. Contract awarded to Oilfields Trucking Co. and Phoenix Const. Co., Inc., Bakersfield, $151,289.05.

KERN COUNTY—At the intersection of U. S. 99 with 11th Avenue, in the City of Delano, a full traffic actuated signal system and highway lighting to be furnished and installed. District VI, Route 4, Westates Electrical Construction Co., Los Angeles, $13,410; L. H. Leonardi Electric Construction Co., San Rafael, $13,999; A-C Electric Co., Bakersfield, $14,565. Contract awarded to Fischbach and Moore, Inc., Los Angeles, $12,971.

LASSEN COUNTY—At two locations, near Standish and between Doyle and Constantia, existing bridges to be replaced with culverts. District II, Route 73, 29, Sections A, E. Eugene G. Alves, Pittsburg, $85,240; Eaton and Smith, San Francisco, $87,601; E. G. McLain, Crescent Mills, $88,-925; Bailey Construction Co., San Rafael, $89,565; O'Connor Brothers, Red Bluff, $92,699; Chittenden and Chittenden and B. S. McElderry, Auburn, $103,-896. Contract awarded to Harms Brothers, Sacramento, $74,650.90.

LOS ANGELES COUNTY—On Sierra Highway, between Tunnel Station and the northerly end of Section H, about 2.0 miles to be resurfaced with plant-mixed surfacing. District VII, Route 23, Sections L. A., H. Griffith Co., Los Angeles, $41,965; Schroeder and Co., Sun Valley, $42,929; Southwest Paving Co., Sun Valley, $44,714; P. J. Akmadzich, Sunland, $45,173; G. W. Ellis Construction Co., North Hollywood, $45,460. Contract awarded to Basich Brothers Const. Co. N. L. Basich, R. L. Basich, Garvey, $40,924.85.

LOS ANGELES COUNTY—On the Hill Street relocation between Sunset Boulevard and 200 feet south of Temple Street, about 0.5 mile to be graded and paved with asphalt concrete. District VII, Route 2. Vido Kovacevich Co., South Gate, $220,325; J. E. Haddock, Ltd., Pasadena, $255,718; Griffith Co., Los Angeles, $264,859. Contract awarded to Webb and White, Los Angeles, $199,646.20.

LOS ANGELES COUNTY—In the City of Santa Monica on the Palisades Beach Road, between Westerly Tunnel Portal at Colorado Ave. and California Ave. Incline, about 0.9 mile in length, plant-mixed surfacing to be placed over existing surfacing and shoulders to be constructed of untreated rock base and plant-mixed surfacing. District VII, Route 60. Vernon Paving Co., Inc., Los Angeles, $28,256; Jesse S. Smith, Glendale, $28,850; C. O. Sparks, Inc., and Mundo Engineering Co., Los Angeles, $31,345; R. R. Hensler, Sun Valley, $34,820. Contract awarded to Schroeder and Co., Sun Valley, $27,594.75.

LOS ANGELES COUNTY—In the City of Los Angeles, on Pacific Coast Highway between Vermont Ave. and Figueroa St., about 0.6 mile, plant-mixed surfacing to be placed on existing surfacing and shoulders constructed and surfaced with plant-mixed surfacing on untreated rock base. District VII, Route 60. Griffith Co., Los Angeles, $59,063; Sully Miller Contracting Co., Long Beach, $67,349. Contract awarded to Warren Southwest, Inc., Torrance, $56,795.

LOS ANGELES COUNTY—On Mint Canyon Highway, between 0.5 mile south of Southern Pacific Railroad Overhead and Solamint, about 0.9 mile to be resurfaced with plant-mixed surfacing. District VII, Route 23, Section I. Schroeder and Co., Sun Valley, $19,787; Southwest Paving Co., Sun Valley, $20,913; P. J. Akmadzich, Sunland, $21,445; Griffith Co., Los Angeles, $21,530; G. W. Ellis Construction Co., North Hollywood, $21,860. Contract awarded to Basich Brothers Const. Co., N. L. Basich, R. L. Basich, Garvey, $18,685.

LOS ANGELES COUNTY—On Lakewood Boulevard, between Carson Street and Center Street, about 3.7 miles, shoulders to be excavated and untreated rock base and plant-mix surfacing placed thereon. District VII, Route 168, Sections A, LBch. Vido Kovacevich Co., South Gate, $166,445; Sully-Miller Contracting Co., Long Beach, $168,004; Warren Southwest, Inc., Torrance, $172,036; Griffith Co., Los Angeles, $176,830; C. O. Sparks, Inc. and Mundo Engineering Co., Los Angeles, $184,540; Oswald Brothers Co., Los Angeles. $194,275; Fredericksen and Kasler, Sacramento, $201,910. Contract awarded to M. S. Mecham and Sons, South Gate, $157,003.30.

LOS ANGELES COUNTY—In the City of Redondo Beach, at the intersection of Pacific Coast Highway with Vincent Street, traffic signal system to be furnished and installed. District VII, Route 60. Electric and Machinery Service, Inc., South Gate, $3,028; Fischbach and Moore, Inc., Los Angeles, $3,132; Westates Electrical Construction Co., Los Angeles, $3,381. Contract awarded to C. D. Draucker, Inc., Los Angeles, $2,948.

LOS ANGELES COUNTY—At the intersection of Rosemead Boulevard with California Street, traffic signal system and highway lighting to be furnished and installed. District VII, Route 168, Section C. C. D. Draucker, Inc., Los Angeles, $11,731; Electric and Machinery Service, Inc., South Gate, $11,-862; Fischbach and Moore, Inc., Los Angeles, $11,966; Westates Electrical Construction Co., Los Angeles, $12,321. Contract awarded to Paul R. Gardner, Ontario, $11,072.

LOS ANGELES COUNTY—At the intersestion of Pacific Coast Highway with Topanga Canyon Boulevard, traffic signal system and highway lighting to be furnished and installed. District VII, Route 60, 156, Sections B, A. Electric and Machinery Service, Inc., South Gate, $12,123; Fischbach and Moore, Inc., Los Angeles, $12,816; C. D. Draucker, Inc., Los Angeles, $13,276. Contract awarded to Westates Electrical Construction Co., Los Angeles, $11,966.

MADERA COUNTY—Between Cottonwood Creek and north city limits of Madera, about 4.1 miles, existing pavement to be resurfaced with plant mixed surfacing and widened with plant-mixed surfacing on untreated rock base. District VI, Route 4, Section A. Guy F. Atkinson Co., South San Francisco, $89,337; Gene Richards, Fresno, $95,894; Volpa Brothers, Fresno, $96,070; J. Henry Harris, Berkeley, $98,721; Thomas Construction Co., Fresno, $101,762. Contract awarded to P. J. Moore and Son, Tracy, $87,187.40.

MONO COUNTY—Between 5.5 and 2.9 miles south of Benton Station, about 2.8 miles to be graded and road-mixed surfacing to be placed on imported base material. District IX, Route 76, Section B. Bailey Construction Co. and Bishop Engineering and Construction Co., Bishop, $99,004; Arthur A. Johnson, Laguna Beach, $993,479; Flickinger-Welker, Los Angeles, $103,864; Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $119,298; E. C. Young, San Fernando, $143,842; C. V. Kenworthy, Stockton, $191,064. Contract awarded to Anderson Co., Visalia, $77,048.

MONO COUNTY—Between Dressler's Corner and 1.1 miles north of Fales Hot Springs, about 12 miles, shoulders to be widened and surfaced with road-mixed surfacing on imported base material. District IX, Route 23, Section I. Browne and Krull, Hayward, $51,770. Contract awarded to Oilfields Trucking Co. and Phoenix Construction Co., Inc., Bakersfield, $48,662.

MONO COUNTY—At Cadillac Curve, about 1.5 mile south of Tom's Place, about 0.3 mile of roadway to be graded and surfaced with road-mixed surfacing. District IX, Route 23, Section B. Ken Lowe, San Bernardino, $19,151; Anderson Co., Visalia, $19,859. Contract awarded to Conrad Construction Co., Inc., Ojai, $14,525.50.

MONTEREY COUNTY—Between Chualar and Spence Underpass, about 5.2 miles to be graded and surfaced with Portland cement concrete pavement on imported subbase material with the upper portion cement treated. District V, Route 2, Section B. Granite Construction Co., Watsonville, $524,905; Ball and Simpson, Berkeley, $528,559; Guy F. Atkinson Co., South San Francisco, $533,228; M. J. B. Construction Co., Stockton, $569,370; Madonna Construction Co., San Luis Obispo, $584,360. Contract awarded to Fredrickson and Watson Construction Co., Oakland, $513,377.80.

MONTEREY COUNTY—Between Moss Landing and two miles south of Watsonville Airport, 2.1 miles to be surfaced with plant mixed surfacing and seal coats applied. District V, Route 56, Section J. Granite Construction Co., Watsonville, $35,300; Browne and Krull, Hayward, $37,690. Contract awarded to Leo F. Piazza Paving Co., San Jose, $33,707.66.

PLACER COUNTY—At Deadman's Curve, about 1.3 miles south of Nevada County line, about 0.2 mile to be graded and surfaced with plant-mixed surfacing on untreated rock base constructed on selected material. District III, Route 17, Section C. Baker Trucking Co., Hamilton City, $24,846; O'Connor Brothers, Red Bluff, $26,832; Rice Brothers, Inc., Marysville, $29,494; J. Henry Harris, Berkeley, $29,742. Contract awarded to Joe Chevreaux, Auburn, $17,084.19.

PLACER COUNTY—Between Oak Street and Holt Street in the City of Roseville for landscaping. District III, Route 3. Capital Nursery Co., Sacramento, $15,445. Contract awarded to Dana R. Tyson Co., Sacramento, $11,268.86.

RIVERSIDE COUNTY—Between the Southern Pacific Railroad and Sedgwick Avenue in the City of Riverside, about 0.35 mile of roadway to be widened and surfaced with plant-mixed surfacing on cement treated base and existing pavement to be resurfaced with plant-mixed surfacing. District VIII, Route 19. E. E. Yeager Co., Riverside, $45,016. Contract awarded to R. A. Erwin, Colton, $36,349.

RIVERSIDE COUNTY—In the City of Beaumont, between the west city limits and the east city limits, about 1.2 miles to be surfaced with plant-mixed surfacing. District VIII, Route 26. R. A. Erwin, Colton, $24,085; Fredericksen and Kasler, Sacramento, $28,632; G. W. Ellis Construction Co., North Hollywood, $37,575. Contract awarded to Matich Brothers, Colton, $23,993.

RIVERSIDE COUNTY—Between Indio and Avenue 62, about 9.3 miles, a portion to be graded and surfaced with plant-mixed surfacing on cement treated base to provide a divided highway, the existing pavement on the remainder of the project to be surfaced with plant-mixed surfacing and seal coats applied. District XI, Routes 26, 64, Sections Ind. F, Coa, Ind. Basich Brothers Construction Co., N. L. Basich and R. L. Basich, Garvey, $369,587; R. A. Erwin, Colton, $378,178; R. R. Hensler, Sun Valley, $392,867; Griffith Co., Los Angeles, $393,112; Peter Kiewit Sons Co., Arcadia, $411,423; R. P. Shea Co., Indio, $436,107. Contract awarded to John J. Swigart Co., Torrance, $349,980.05.

SAN BERNARDINO COUNTY—On Main Street through Barstow and from Main Street to North Junction with Route 58 portions about 3.4 miles in net length, plant-mixed surfacing to be placed over existing pavement. District VIII, Route 31, 58, Sections Bsw., G. James E. Miller and Sons, Los Angeles, $67,675; George Herz and Co., San Bernardino, $68,316; Basich Brothers Construction Co., N. L. Basich, R. L. Basich, Garvey, $71,200; G. W. Ellis Construction Co., North Hollywood, $71,757; E. E. Yeager Co., Riverside, $79,506; R. A. Erwin, Colton, $98,380. Contract awarded to Peter Kiewit Sons' Co., Arcadia, $66,824.

SAN BERNARDINO AND RIVERSIDE COUNTIES—Between 1.5 mile northwest of the Riverside County line in San Bernardino County and the City of Beaumont in Riverside County, highway lighting and illuminated sign bridge to be furnished and installed. District VIII, Route 26, Sections B, A, Bau. Fischbach and Moore, Inc., Los Angeles, $20,488; Electric and Machinery Service, Inc., South Gate, $21,037. Contract awarded to Paul R. Gardner, Ontario, $19,225.

SANTA CLARA COUNTY—Furnish and install a traffic signal system in the City of Los Gatos at the intersection of Main Street and Santa Cruz Avenue. District IV, Routes 5, 42, Section LGts. L. H. Leonardi Electric Construction Co., San Rafael, $10,502; Severn Electric Co., San Francisco, $11,023; Abbett Electric Corp., San Francisco, $12,410; Fields Electric Works, Santa Clara, $15,121. Contract awarded to Howard Electric Co., Gilroy, $9,839.

SANTA CRUZ COUNTY—Repair a timber trestle pier in Seacliff Beach State Park about 8 miles east of Santa Cruz. District IV, Seacliff Beach State Park. Granite Construction Co., Watsonville, $13,835; Barnhart Construction Co., Santa Clara, $13,895; C. C. Gildersleeve, Nevada City, $15,970; L. W. Jenson and A. E. Mangs, Palo Alto, $18,406; B. S. McElderry, Berkeley, $19,440. Contract awarded to Barton Construction Co., Oakland, $11,608.04.

SAN DIEGO COUNTY—Between Chambers Street in El Cajon and Second St., about 2.0 miles to be grades and paved with plant-mixed surfacing on cement treated base. District XI, Route 12, Section ECJ, B. C. Griffith Co., Los Angeles, $203,012; Daley Corp., San Diego, $212,533; V. R. Dennis Construction Co., San Diego, $219,790. Contract awarded to R. E. Hazard Contracting Co., San Diego, $189,828.75.

SAN FRANCISCO COUNTY—At San Francisco-Oakland Bay Bridge, upper deck painting scaffold track in Yerba Buena Island Truss Spans between Pier YB-1 and Pier E-1, to be constructed. District IV, Route 68. Herrick Iron Works, Oakland, $30,100; Moore Dry Dock Co., Oakland, $37,100. Contract awarded to California Steel Products Co., Richmond, $21,630.

SAN MATEO COUNTY—In the City of Daly City, at the intersections of Mission Street with San Jose Avenue and with Market Street, full traffic actuated signal systems to be furnished and installed and challelization to be constructed at two intersections. District IV, Route 2, Section DlC. Charles E. Harney, Inc., San Francisco, $63,567; J. Henry Harris, Berkeley, $64,605; Eaton and Smith, San Francisco, $74,794. Contract awarded to R. Flatland, San Francisco, $57,644.

VENTURA COUNTY—Between Route 2 and Santa Clara River about 3.9 miles to be surfaced with plant-mixed surfacing and seal coat applied. District VII, Route 9, Section A. Baker and Pollock, Ventura, $38,783; Griffith Co., Los Angeles, $42,526. Contract awarded to Conrad Construction Co., Inc., Ojai, $38,234.

F. A. S. County Routes

SAN DIEGO COUNTY—On Penasquitos-Poway Road between State Highway Route 77 and San Diego County Road Survey 944, about 3.6 miles to be graded. District XI, Route 729. Flickinger-Welker, Los Angeles, $202,733; Einer Brothers, Inc., Escondido, $207,794; Sim J. Harris Co., San Diego, $228,091; Arthur A. Johnson, Laguna, $236,900; Cox Brothers Construction Co., Stanton, $272,141; Clifford C. Bong and Co., Arcadia, $274,383; L. A. and R. S. Crow, El Monte, $280,201; Basich Brothers Construction Co. and N. L. Basich and R. L. Basich, Garvey, $301,207. Contract awarded to Ralph A. Bell, Monrovia, $202,277.

MONTEREY COUNTY—At Elkhorn Slough on Old Toll Road, about 3½ miles south of Pajaro, about 0.5 mile to be graded and culverts installed. District V, Route 593. Louis Biosotti and Son, Stockton, $79,220; M. Malfitano and Son, Inc., Pittsburg, $87,740; Thomas Construction Co., Fresno, $89,089; Granite Construction Co., Watsonville, $99,498; Eugene G. Alves, Pittsburg, $118,648. Contract awarded to Edward Keeble, San Jose, $54,153.

May, 1951

CONTRA COSTA COUNTY—Between Luzon Underpass and Christie Underpass, about 3.1 miles, portions of roadway to be graded and surfaced with plant-mixed surfacing on cement treated base over imported subbase material and applying seal coats. District IV, Route 106, Section A. J. R. Armstrong, El Cerrito, $126,428; Ransome Co., Emeryville, $131,248; Eugene G. Alves, Pittsburg, $142,801; J. Henry Harris, Berkeley, $150,980. Contract awarded to Lee J. Immel, San Pablo, $122,883.

HUMBOLDT COUNTY—Between Trinidad and 2.8 miles northerly, about 0.5 mile to be graded, and about 2.8 miles of cement treated base to be constructed and surfaced with plant mixed surfacing. District I, Route 1, Section Trnd.-J. Harms Brothers and C. M. Syar, Sacramento, $163,614. Contract awarded to Mercer, Fraser and Co. and Mercer Fraser Gas Co., Inc., Eureka, $145,099.75.

IMPERIAL COUNTY—On Main Street between First Street and east city limits of El Centro, a distance of about 0.5 mile to be graded, surfaced with road-mixed surfacing on cement treated base and on the existing pavement, and storm drains to be installed. District XI, Route 27, Section ECn. J. L. McElvany, El Centro, $89,422. Contract awarded to Anderson Co., Visalia, $74,675.50.

IMPERIAL COUNTY—Between Dixieland and El Centro, between 2 miles north of Sandy Beach Road and the Riverside County line, between East Highline Canal and Colorado River, between Holtville and Calipatria, and between Heber and Brawley, about 46 miles, plant-mixed surfacing to be placed over existing surfacing on portions of project and over imported base material on other portions of the project. District XI, Routes 12, 26, 27, 187, 201, Sections C, CDE, AB, BCD, AB. R. R. Hensler, Sun Valley, $484,940. Contract awarded to Basich Brothers Construction Co., N. L. Basich and R. L. Basich, Garvey, $470,990.

INYO COUNTY—At Bishop Creek, about 7.1 miles west of Bishop, existing timber bridge to be replaced with double 8' x 3' 91' 2" field-assembled plate arch culvert; and the roadbed to be graded and bituminous surface treatment applied to imported base material. District IX, Route 76, Section B. Bishop Engineering and Construction Co., Bishop, $14,551; Anderson Co., Visalia, $17,320. Contract awarded to Conrad Construction Co., Inc., Ojai, $13,202.04.

KERN COUNTY—Across Goose Lake Slough, about 10 miles south of Shafter, a reinforced concrete slab bridge on concrete piers and abutments with concrete pile foundations to be constructed. District VI, Route 139, Section A. Norman I. Fadel, North Hollywood, $47,703; Thomas Construction Co., Fresno, $48,936; E. G. Perham, Los Angeles, $49,436; C. B. Tuttle Co., Long Beach, $50,880; Volpa Brothers, Fresno, $52,171; Walter Kaucher, Los Angeles, $52,938; McClain Construction Co., Inc., Hawthorne, $57,847. Contract awarded to Tumblin Co., Bakersfield, $42,505.60.

LOS ANGELES COUNTY—At Central Maintenance Station between the frontage road of Santa

Ana Freeway and Slawson Ave., about one-half mile easterly of Garfield Ave., three buildings to be constructed. District VII, Route 166, Section A. D. C. Leneve, Inc., Montebello, $39,627; Ray V. Anderson, Los Angeles, $45,619. Contract awarded to Manderbach Construction Co., Glendale, $36,438.

LOS ANGELES COUNTY—On Centinela Avenue, between Freeman Boulevard and Sepulveda Boulevard, about 1.5 miles, the existing pavement to be widened with untreated rock base and the existing pavement and newly constructed untreated rock base surface with plant-mixed surfacing. District VII, Route 164, Section Ing. LA. A. Vido Kovacevich Co., South Gate, $195,837; Warren Southwest, Inc., Torrance, $197,322; J. A. Thempson and Son, Inglewood, $201,156; Vernon Paving Co., Los Angeles, $203,300; Jesse S. Smith and Service Construction Co., of Southern California, Burbank, $212,412; Tomei Construction Co., Van Nuys, $226,045. Contract awarded to Oswald Brothers Co., Los Angeles, $180,527.50.

LOS ANGELES COUNTY—In the City of San Gabriel, at the intersections of Valley Boulevard with Isabel Avenue and with Walnut Street, traffic signal systems to be furnished and installed. District VII, Route 77. C. D. Draucker, Inc., Los Angeles, $5,910; Electric and Machinery Service, Inc., South Gate, $6,082; Fischbach and Moore, Inc., Los Angeles, $6,245; Westates Electrical Construction Co., Los Angeles, $6,260. Contract awarded to Clinton Electric Corp., Burbank, $5,683.

LOS ANGELES COUNTY—Between Parkman Avenue and Grand Avenue, about 2.2 miles of roadside areas to be prepared and planted. District VII, Route L. A.-2-L. A. D. and M. Sprinkler Co., Long Beach, $36,122; Moulder Brothers, Glendale, 42,700; Stephen L. Vistica, San Mateo, $44,565; Henry C. Soto Corp., Los Angeles, $56,054; Jannoch Nurseries, Altadena, $69,535. Contract awarded to James E. Bootbe, Compton, $35,633.76.

MENDOCINO COUNTY—At Middle Creek, about 1½ miles east of Ukiah, an existing bridge to be widened and about 0.3 mile of approaches to be graded and surfaced with road-mixed surfacing on cement treated base. District I, Route 70, Section A. O'Connor Brothers, Red Bluff, $41,609; J. Henry Harris, Berkeley, $52,785. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, $34,494.50.

NAPA COUNTY—Between 6.5 and 6.8 miles east of the city limits of Napa, about 0.3 mile to be graded and seal coat applied. District IV, Route 6, Section A. J. Henry Harris, Berkeley, $29,468. Contract awarded to C. M. Syar, Vallejo, $26,856.50.

ORANGE COUNTY—On Garden Grove Boulevard between Stanton Avenue and the P. E. R. R. in Garden Grove, about 3 miles existing shoulders to be graded to provide additional width for surfacing; untreated rock base to be placed and plant-mixed surfacing to be placed over existing pavement and new base. District VII, Route 179, Section A. Sully-Miller Contracting Co., Long Beach, $72,552; John J. Swigart Co., Torrance, $77,986; Cox Brothers Construction Co., Stanton, $82,746; Griffith Co., Los Angeles, $83,285; Warren Southwest, Inc., Torrance, $100,441; Pacific Rock and Gravel, Monrovia, $147,220. Contract awarded to Roland T. Reynolds, Anaheim, $70,797.50.

RIVERSIDE COUNTY—Between Indio and Black Butte, about 22.4 miles to be resurfaced with plant-mixed surfacing. District XI, Route 64, Sections H, I, B, C, D. R. R. Hensler, Sun Valley, $162,950; Basich Brothers Construction Co., N. L. Basich and R. K. Basich, Garvey, $163,506; George Herz and Co., San Bernardino, $170,270; Peter Kiewit Sons' Co., Arcadia, $173,310. Contract awarded to James L. Miller and Sons, Los Angeles, $159,470.

RIVERSIDE COUNTY—Between two miles west of Hemet and Sanderson Avenue, about one mile to be graded and surfaced with plant-mixed surfacing on imported base material. District VIII, Route 64, Section K. E. L. Yeager Co., Riverside, $54,751; George Herz and Co., San Bernardino, $55,523; Matich Brothers, Colton, $56,713. Contract awarded to R. A. Erwin, Colton, $47,998.50.

SACRAMENTO COUNTY—At the bridge across the Sacramento River about 1.3 miles north of Isleton for reconstructing a timber fender. District III, Route 11, Section D. Lord and Bishop, Sacramento, $6,998; Healey Tibbitts Construction Co., San Francisco, $7,928. Contract awarded to H. F. Lauritzen, Pittsburg, $5,819.80.

SAN BERNARDINO COUNTY—Across Mojave River at Victorville, and over the tracks of Atchison, Topeka and Santa Fe Railway Co. at Barstow, two existing steel bridges to be cleaned and painted. District VIII, Route 31, Sections D, G. R. W. Reade and Co., Berkeley, $32,341; Acme Maintenance Engineering Co., Montebello, $43,753; G. C. Hewitt and Co., Ltd., Los Angeles, $50,000. Contract awarded to Timmons Painting and Engineering Co., Long Beach, $31,080.83.

SAN MATEO COUNTY—Between 0.2 mile north of Lobitos and 0.3 mile north of Canada Verde Creek, about 3.4 miles to be graded and surfaced with plant-mixed surfacing on imported base material. District IV, Route 56, Section C. John Delphia, Patterson, $369,700; Guy F. Atkinson Co., South San Francisco, $396,750; Ball and Simpson, Berkeley, $426,072; L. C. Smith, San Mateo, $435,540. Contract awarded to S. A. F. Co., Redwood City, $364,903.30.

SIERRA COUNTY—Between 1.4 miles east of Yuba County line and 1.5 miles west of North Yuba River, about 0.8 mile to be graded and bituminous surface treatment applied, and a reinforced concrete girder bridge across Indian Creek to be constructed. District III, Route 25, Section A. M. Malfitano and Son, Inc., and M. W. Brown, Pittsburg, $369,780. Contract awarded to Richter Brothers, Oroville, $313,618.04.

SOLANO COUNTY—Between Vallejo and Davis, portions, about 0.8 mile of frontage road connections to be graded and surfaced and chain link fences to be constructed. District X, Route 7, Sections G, C, D, I. Parish Brothers, Benicia, $86,667. Contract awarded to Fredrickson Brothers, Emeryville, $81,434.70.

SUTTER COUNTY—Between Meridian and three miles west of Yuba City, about 7.1 miles, borders to be constructed of untreated rock base and plant-mixed surfacing on portions of the project and untreated rock base and plant-mixed surfacing to be placed over existing pavement and new borders on a portion of the project. District III, Route 15, Sections A, B. Harms Brothers, Sacramento, $85,007; H. Earl Parker, Inc., Marysville, $87,723. Contract awarded to Rice Brothers, Inc., Marysville, $79,604.90.

VENTURA COUNTY—From Santa Clara River bridge through Montalvo, about 1.3 miles to be graded and paved with plant-mixed surfacing on cement treated base and on existing pavement and outer highways to be constructed to provide a 4-lane divided highway. District VII, Route 2, Section C. Baker and Pollock, Ventura, $375,983; Griffith Co., Los Angeles, $380,613; Matich Brothers and K. and H. Co., Colton, $387,630; J. E. Haddock, Ltd., Cox Brothers Construction Co., Pasadena, $454,018. Contract awarded to Fredericksen and Kasler, Sacramento, $372,755.70.

YOLO COUNTY—Between East Street in Woodland and Yolo By-pass, about 5.1 miles, border trenches to be excavated, imported base material to be placed, and surfaced with plant-mixed surfacing. District III, Route 50, Sections Wd, E. Munn and Perkins, Modesto, $159,907; P. J. Moore and Son, Tracy, $171,018; Harms Brothers, Sacramento, $183,805; Frank B. Marks, Jr., Newman, $208,136; J. R. Reeves, Sacramento, $245,250. Contract awarded to A. Teichert and Son, Inc., Sacramento, $130,940.

F. A. S. County Routes

CONTRA COSTA COUNTY—On Marsh Creek Road between 7.1 miles east of Clayton and 12.4 miles west of Byron, about 0.5 mile to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Route 609. Silva Brothers, Hayward, $67,330; J. Henry Harris, Berkeley, $75,947; M. Malfitano and Son, Inc., Pittsburg, $77,652; C. V. Kenworthy, Stockton, $83,200; Edward Keehle, San Jose, $84,078; Karl C. Harmeling, Stockton, $84,304; Eugene G. Alves, Pittsburg, $84,322. Contract awarded to Louis Biasotti and Son, Stockton, $57,514.

LOS ANGELES COUNTY—Across San Gabriel River on Spring Street, a reinforced concrete girder bridge to be constructed. District VII, Route 751. John Strona, Pomona, $203,456; G. W. Peterson and J. W. Baker, Los Angeles, $230,795; R. M. Price Co. and O. B. Pierson, Altadena, $232,632; Bongiovanni Construction Co., Los Angeles, $240,794; MacDonald and Kruse and Pacific Allied, Sun Valley, $245,562. Contract awarded to Charles MacClosky Co., San Francisco, $188,705.25.

MODOC COUNTY—Between 4 miles north of Lake City and Fort Bidwell, about 12.5 miles to be surfaced with gravel base and road-mixed surfacing. District II, Route 513. Clements and Co., Hayward, $173,887; Harms Brothers, Sacramento, $205,917. Contract awarded to Tyson and Watters, Inc., Sacramento, $155,677.20.

STANISLAUS COUNTY—On Oakdale-Valley Home Road, between State Highway Route 66 and Valley Home, about 3.9 miles, existing pavement to be widened with borders of untreated rock base, existing pavement and borders to be surfaced with plant-mixed surfacing on untreated rock base. District X, Route 904. M. J. Ruddy and Son, Modesto, $73,210. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $68,870.20.

Venture Success

Continued from page 43 . . .

safety, no longer confronted with the hazard of parking directly alongside a main thoroughfare. Also, cars traveling on the main highway are spared the hazard of cars pulling in and out of parking areas alongside the road. This safety factor may not apply to a business such as the new Safeway store, which provides its own parking facilities for customers, but is of particular import to those enterprises not having private parking facilities.

MAGAZINE HELPFUL

BOROUGH ENGINEER'S OFFICE
Town Hall, Ilford, Australia

The Editor,
California Highways and
Public Works Journal

DEAR SIR: After reading several issues of your journal which has been forwarded by Mr. James J. Harman of 1675 38th Avenue, San Francisco 22, California, I am writing to enquire if it could be possible for you to have this council's name put on your mailing list.

The interesting articles dealing with the size and expanse of the vast road works carried out by you are read with great interest by the engineers of this corporation.

Ilford is a municipal corporation consisting of 8,503 acres and a population of approximately 200,000, and I can assure you that your journal will be put in our department library for all technical assistants to peruse.

I am, sir, your truly,

CLAUD H. HARDING
Chief Administrative Assistant

Human Relations

More Important Than Mathematics, Young Engineers Are Told

By JOHN J. MANNING, M. ASCE; Vice Admiral, CEC, USN; Chief, U. S. Bureau of Yards and Docks (Retired); Vice President, John McShain, Inc., Philadelphia, Pa.

YOUNG engineers have a disconcerting knowledge of many things that older engineers have forgotten. However, there are compensations for growing older in the engineering business. As the hard, bright facts of formal education begin to dull with time, we begin to develop a better understanding of human relationships and the ways and means of translating knowledge and ability into effective action. We learn that many phases of engineering have more to do with psychology than mathematics, and that quite often a slide rule can be of far less value than a sense of humor.

Among the qualities of a civil engineer which are less commonly recognized—but which must be acquired if his vital role is to be played out to the full—is the ability to present his case effectively to nonengineers. Frequently the engineer's attitude in this connection may be likened to that of the country man in the old English folktale who went to a village fair. He saw a large crowd gathered about an entertainer who was imitating the squeal of a little pig. The crowd was getting a lot of amusement out of the performance, but the country man thought the imitation a poor one. So the next day he returned and demanded that the crowd listen to his version of the squeal of a young pig. The crowd listened for a minute, then told him his imitation was no good. Whereupon, he reached inside his coat and pulled out the little pig which he had been pinching. The crowd was still unimpressed, and still preferred the professional pig squealer. In other words, it is one thing to have a good product, and it is quite another thing to dramatize that product so that the layman will find it attractive.

Engineers experience a feeling of frustration when all too often they come off second best in their encounters with salesmen and poiticians. The story has been told of a politician and an engineer, who after discussing some project of mutual interest, left the office of the engineer and went to his club for luncheon. As they entered the club they met a gentleman just leaving. The politician greeted him warmly and shook hands with him. As the politician rejoined the engineer, he said, "Don't you know Mr. So-and-So?" The engineer replied, "Yes, I know him." The politician said, "I didn't see you speak to him," to which the engineer answered, "He knows that I know him so why should I speak to him?"

Probably the young engineer will react to this characterization with a certain amount of defensive pride, interpreting the engineer's attitude as an indication of integrity. And probably he will be entirely right. Nevertheless, we should not accept with equanimity the fact that engineers lack the ability to persuade nonengineers to their point of view. Now, I know that the American people consider it an inalienable right to denounce politicians. Yet it must be admitted that the politician is highly skilled in dealing with intangibles. With amazing accuracy he is able to appraise emotions and prejudices and to harness those great human forces which no mathematical formula can measure or evaluate. Far from being contemptuous of such powers, we as engineers should seek to develop them for ourselves.

Avoid Professionol Snobbery

Now, the question is how this can be done. I can't give all the answers, but I can make a few suggestions. The first of these is basic to the others. It is to avoid professional snobbery.

One form of such snobbery is the use of technical and scientific terms which are incomprehensible to the layman. To the young engineer who has just finished a course of intensive training which has taught him to think in technical terms, it may seem that the nonengineering mind is filled with cobwebs. Nevertheless, the engineer who possesses humility rather than arrogance in dealing with nonengineers is going to profit in the long run—and, for that matter, in the short run too. The farther engineers get from their theoretical training, the more value they will attach to those human relationships which are based upon openmindedness and mutual respect.

Security Versus Professionol Growth

Another important point is the tendency of young engineers to seek economic security at almost any sacrifice. Not long ago, the bureau made a survey of senior engineering students in college to determine what they considered the most important inducement in a job opening. The majority wanted job security. Almost as many were interested primarily in salary. And close to the bottom on the survey were those few who wanted only the opportunity to develop professionally. A young man's desire for security is easy to understand, but security should not be sought for its own sake. It should come as the result of ambition, enthusiasm and hard work.

Some 70 years ago Ralph Waldo Emerson told a student audience: "When you are willing to renounce your ideals and ambitions for premature comforts and security, then dies the man in you, then once more perish the buds of art and poetry and science as they have died already in a thousand men. Explore and explore. Be neither chided nor flattered out of your position of perpetual inquiry. . . . Why

should you renounce your right to traverse the starlit deserts of truth . . . for premature comforts?"

Another suggestion concerns the importance of speaking and writing effectively. Last year, because of the importance I attach to these abilities, I authorized groups of my co-workers to attend weekly classes in public speaking. The result was surprising. Men whose personal courage had never been in doubt and whose coats were covered with campaign ribbons and battle stars, had the look of boot sailors under fire for the first time. And the instructor informed me that they certainly must be good engineers because, with a couple of exceptions, they were the world's worst public speakers.

Frankly, that doesn't make sense. Those few engineers who have taken the trouble to rid themselves of the phobia against public speaking have been outstandingly successful. An example is my predecessor as Chief of the Bureau of Yards and Docks, Admiral Ben Morreell, Hon. M. ASCE, now President of Jones and Laughlin Steel Corp., who is an extremely effective speaker. And this ability played no small part in his success.

What has been said about the ability to speak in public applies with even greater force to the ability to write persuasive English. Unless young engineers have changed more than I think they have, they still study English with a minimum of enthusiasm—regarding it largely as a form of gibberish which liberal arts students use to wrangle a degree without doing any work.

The ability to speak and to write effective English will aid the engineer not only to persuade his fellow engineers, but the people who hire engineers and who let contracts for construction and for engineering services. And ultimately, if the profession is to obtain the stature and the influence it deserves, the engineer must be able to plead its cause by persuasive writing directed to the public. The alternative is to accept the status of a hired technician.

Modern life is so closely integrated that the individual no longer can operate as an independent machine. He is part of the larger machine which is his community, and of the still larger one which is his country. In fact, we can hope that the day is not too distant when national barriers will be lowered to permit a true comity of nations.

Engineers' Activity Needed for Peace

In the meantime, our prime concern must be that the United States serve as the most powerful instrument for achieving order and peace. Unlike the groundless optimism indulged in after World War I, it is now realized that true peace is an elusive thing, which only continuing effort will attain. We have learned the hard way that Utopia is not "for free." Our Country needs the engineer's active participation, his ideas, his enthusiasm, and his ability in the military reserve organizations. Passive support is not enough. The Nation's influence for peace is only as strong as the force which lies behind it. We are citizens first and engineers second.

My advice to the young engineer is, in brief, to go beyond the narrow horizon of his technical training to the broader horizon of usefulness and influence in his community. If the young engineer recognizes that his fellow men can offer him as much as he can offer them, and that humility offers a faster road to success than pride and intolerance, he will reap rich satisfaction both as an engineer and as a citizen.

FROM A STUDENT

Los Angeles 7, California

California Highways and Public Works
Sacramento, California

Dear Sirs: For the past several years I have been reading your excellent magazine in the school and public libraries. It is undoubtedly the best periodical of its type in the country.

Although I am an electrical engineering student at University of Southern California, I am intensely interested in highway engineering and development. The articles on land values and effects on business properties adjacent to freeway developments are of particular value.

Yours sincerely,

Robert W. Logue

Moving Forward

Continued from page 16 . . .

Design in Progress

Between 223d Street and the Santa Ana Freeway designs are now in progress for the remaining portion of the Los Angeles River Freeway. These designs will include studies for future connection with the Terminal Island Freeway for which the northerly terminus now is Willow Street. Access to the U. S. Naval Base on Terminal Island and to the defense industries on the island will be greatly improved when the connection is made between the present north end of the Terminal Island Freeway and the new Los Angeles River Freeway. The Terminal Island Freeway is not on the State Highway System, and the responsibility for making this connection rests with the Navy.

The present three-mile length of the Terminal Island Freeway was designed by the Division of Highways and a considerable portion of it constructed under state highway contracts as a part of the federal access road program carried out during the war and immediately thereafter, and this work was financed by funds provided by the U. S. Bureau of Public Roads and the Navy.

Complicated Crossing

One of the major problems of design is the complicated crossing of the Los Angeles River Freeway by the Pacific Electric Railway and the Union Pacific Railway which cross each other at approximately right angles at the location of the Los Angeles River Freeway. The State is conducting negotiations with the U. S. Engineers looking toward cooperative financing of the cost of constructing these railroad grade separations at ultimate grades in the immediate vicinity of the freeway crossing in order that the tracks will fit in the planned 12-foot ultimate raise of the river levees. This work is under consideration by the Los Angeles County Flood Control District at this time.

Roadway interchange systems and grade separations are also being designed at crossings of Long Beach Boulevard, Artesia Street, Atlantic

. . . Continued on page 52

Moving Forward

Continued from page 51 . . .

Avenue, Rosecrans Avenue, Platt Avenue, Imperial Highway, Firestone Boulevard, Florence Avenue, Atlantic Boulevard, Bandini Boulevard and Washington Boulevard.

Railroad grade separation problem studies are in progress where crossings of the freeway are made with the Pacific Electric Railway main line to Santa Ana, the main line of Union Pacific Railway, the Central Manufacturing District house tracks that are now serving the various industrial plants in the Bandini area, and the main lines to the east of the A. T. & S. F. and Union Pacific Railroads.

Freeway agreements have been entered into with the Cities of South Gate, Lynnwood, Compton, Long Beach and the County of Los Angeles so that the entire length, 16.2 miles, of the Los Angeles River Freeway between its southerly terminus at Pacific Coast Highway and its northerly terminus at the junction of the Santa Ana Freeway has been covered by freeway agreements.

In the establishment of the Los Angeles River Freeway location every effort has been made to cause the least possible interference with existing industries. A freeway, such as the Los Angeles River Freeway, cannot be located so as to be entirely in the clear of all important installations. It is unfortunate that there is no way to avoid interference with the oil refinery facilities of the Richfield Oil Company northerly of Firestone Boulevard or the manufacturing plant of the American Brake Shoe Company near Slauson Avenue. Another very important installation, which is affected, is the U. S. Army 822d Air Force Specialized Depot in Maywood. Many conferences have been held with high ranking officers of the Air Force in connection with the freeway location in this vicinity. A design has been worked out which causes a minimum of damage to the Air Force installations. None of the buildings will be affected by the freeway construction but many alterations will have to be made in the railroad siding tracks.

The Los Angeles River Freeway connecting as it will the vast industrial and manufacturing areas easterly of the City of Los Angeles with Long Beach Harbor facilities, is of vital importance as a major north and south traffic artery. The total estimated cost of this freeway is about $30,000,000 for the 16.2 miles. This is an average cost of considerably less than $2,000,000 a mile, which is very low for a modern six-lane freeway complete with grade separation structures at all important cross streets and all railroad tracks. This freeway will undoubtedly be classified as of strategic military importance and it can be expected that each year substantial allocations will be made in future state highway budgets so that this freeway can be completed as rapidly as possible.

OFF WITH THE OLD; ON WITH THE NEW

In his column "On the Square" appearing in the *Pasadena Independent* on May 20th last, Ed Essertier has this comment:

"MONEY'S WORTH — Just 40 years ago this week, the city bonded itself for $100,000 to pay half the cost of the Colorado Street bridge. (The county paid the other half.) This week, as a new $3,500,000 bridge begins taking shape, city directors will make the last payment on the old one. Total interest on the bonds, at 4½ percent over 40 years, has been $92,250."

COLLEGE APPRECIATIVE

COMPTON COLLEGE
Compton, California

June 4, 1951

Kenneth C. Adams, *Editor California Highways and Public Works*, Sacramento, California

Dear Editor, I am writing to again express the appreciation of myself and our institution of the receipt of your magazine, *California Highways and Public Works*, during the passed school year.

This publication has been circulated in our economic and government classes, now numbering in excess of 600 students. We find such material to be of practical value in supplementing the basic course content.

Cordially yours,
Robert C. Gillingham, Chairman
Social Science Department

TESTIMONIAL DINNER

Four hundred-odd co-workers and friends of Thomas E. Stanton tendered him a testimonial dinner on the night of May 25th. The affair was held in Governor's Hall on the State Fair Grounds in Sacramento. Many sections of the State were represented.

Mr. Stanton was presented with a number of gifts among which was a bound volume of hundreds of letters and telegrams from almost every state in the Union and from foreign countries wishing him a happy retirement. Also he was given $500 worth of camera equipment, including a camera and projector.

Thomas E. Stanton

Continued from page 10 . . .

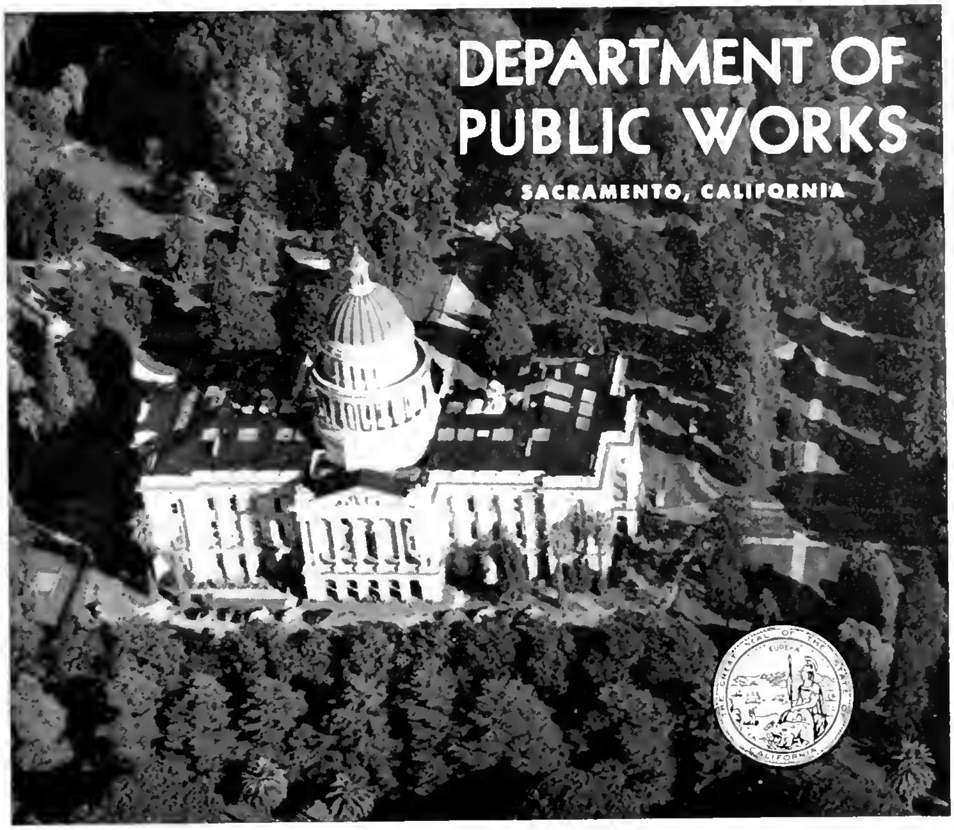
often been impressed by his ability to direct the activities and especially his capacity to introduce a strong element of sanity and common sense on those occasions when ill-advised or unsound moves have been proposed. It is not difficult for a man in a position of authority to control and direct the organization that must look to him for guidance. It does require a much higher type of ability to guide the actions and procedures of a group in a democratic meeting where many suggestions are inevitably made without considering the long range effects of or all of the implications.

In addition to his many contributions toward the security and welfare of his fellow-employees, Tom Stanton has also established in the minds of those who have known him and worked with him a reputation for personal integrity that is equaled by few, and quoting one of his subordinates who worked in close contact with him for nearly 20 years, "Mr. Stanton is the most honest man whom I have ever known."

EARL WARREN
Governor of California

CHARLES H. PURCELL
Director of Public Works

FRANK B. DURKEE
Deputy Director



HIGHWAY COMMISSION

C. H. PURCELL . . . . Chairman
HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego
R. C. KENNEDY, Secretary . . . . . Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . State Highway Engineer
R. M. GILLIS . . . . Deputy State Highway Engineer
CHAS. E. WAITE . . Assistant State Highway Engineer
EARL WITHYCOMBE . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
F. N. HVEEM . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
E. T. TELFORD . . . . Engineer of Design
DON G. EVANS . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
J. P. MURPHY . . . . Principal Highway Engineer
E. J. SALDINE . . . . Principal Highway Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGTRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

District VII

P. O. HARDING . . Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . District VII, Los Angeles
S. W. LOWDEN . . . . District VIII, San Bernardino
ALAN S. HART . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge

DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO TOLL CROSSINGS

NORMAN C. RAAB . . . . Project Design Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . . State Engineer, Chief of Division
P. H. VAN ETTEN . . . . Assistant State Engineer
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
HARVEY O. BANKS . Supervising Hydraulic Engineer, Water Pollution Control Investigations
WILLIAM BERRY
Supervising Hydraulic Engineer, California Water Plan
MAX BOOKMAN
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
H. S. HUNTER . . . . Deputy Chief
ROBERT W. FORMHALS
Administrative Assistant to State Architect
EARL W. HAMPTON . Supervisor of Contract Architects

Administrative Service

W. K. DANIELS . Assistant State Architect, Administrative
WADE O. HALSTEAD
Principal Estimator of Building Construction
CARLETON PIERSON . . Supervising Contracts Writer

Planning and Design Service

P. T. POAGE
Assistant State Architect, Design and Planning
A. F. DUDMAN . . . Principal Architectural Designer
CARL A. HENREDLONG
Principal Mechanical and Electrical Engineer
C. L. IVERSON
General Supervising Architectural Draftsman
ELLIOTT ADAMS . . . Architectural Property Analyst
WALTER E. LORD . Supervising Specifications Writer
JAMES A. GILLEM . Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT . . . . Chief Construction Engineer
F. A. JOHNSON . . . . Principal Structural Engineer
JOHN S. MOORE . . . General Construction Superisor
NATE W. DOWNES
Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN . . . . . . Area I, Oakland
W. H. EPPERSON . . . . Area II, Sacramento
FRANK R. AUSTGEN . . . . Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD . . . . Area I, San Francisco
M. A. EWING . . . . Area II, Sacramento
H. W. BOLIN . . . . Area III, Los Angeles

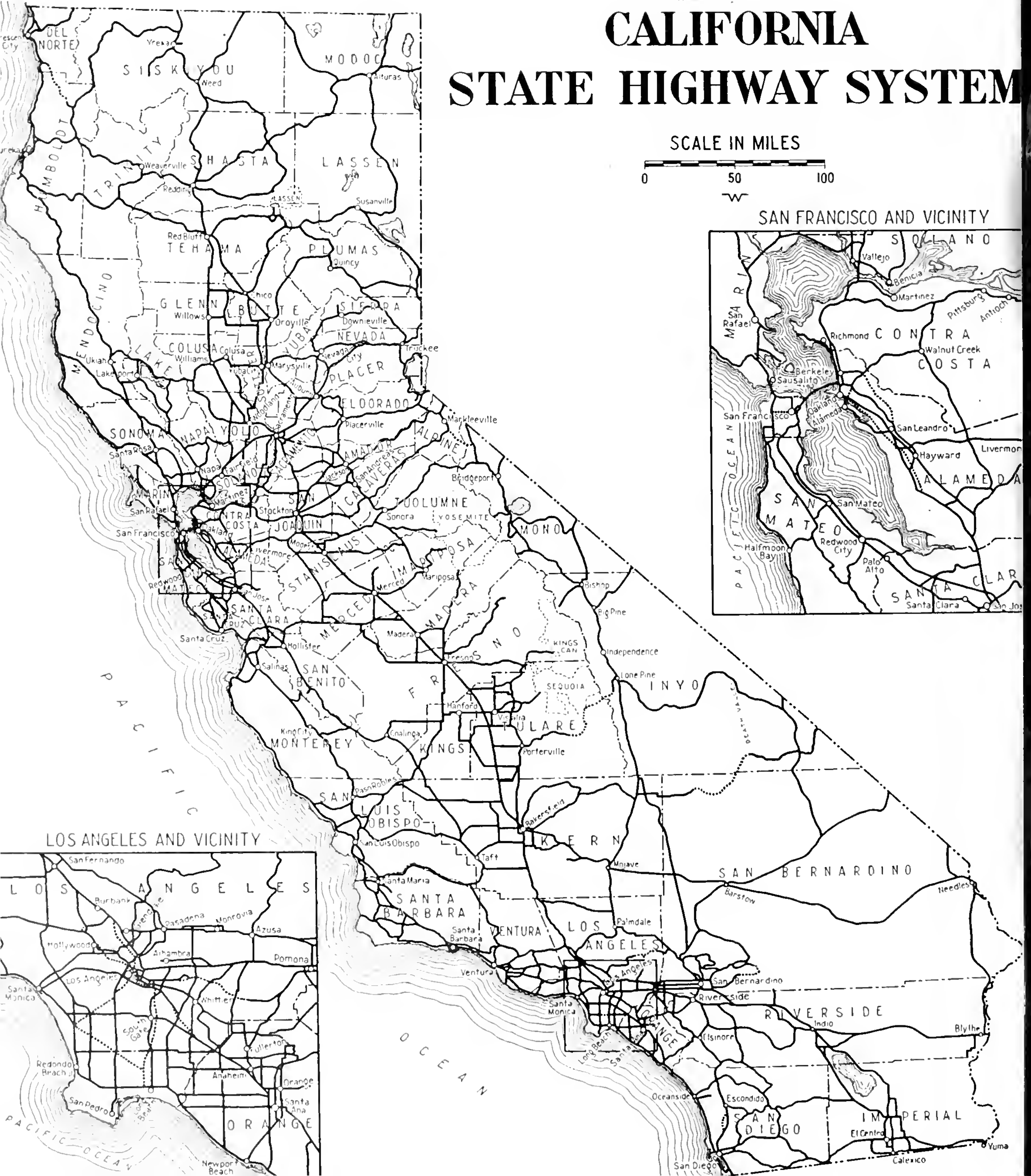
printed in CALIFORNIA STATE PRINTING OFFICE 44350 5-51 29M

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

CALIFORNIA STATE HIGHWAY SYSTEM



CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK B. DURKEE, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. BOX 1499
Sacramento, California

Vol. 30 July-August Nos. 7, 8

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

Great Loss

Charles H. Purcell Retires as Director Of State Department of Public Works

THE STATE OF CALIFORNIA has lost the ervices of one of the most distin- ;uished engineers of our time.

Charles Henry Purcell, Director of 'ublic Works and Chairman of the California Highway Commission, internationally famous builder of highways and bridges, retired on July 1st.

As State Highway Engineer, to which post he was appointed by Governor C. C. Young in February, 1928, he conceived and supervised the building of the San Francisco-Oakland Bay Bridge, in enduring monument to his genius.

In January, 1943, he was named head of the Department of Public Works by Governor Earl Warren.

His unflagging devotion to duty during a period of 23 years in State Government has been an inspiration to all who had the privilege of knowing him and observing his work and achievements.

In announcing to the press on July 26th that he had regretfully accepted Mr. Purcell's resignation, Governor Warren said:

"It is with the deepest regret that I have accepted the resignation of Charlie Purcell as Director of the Department of Public Works. Charlie has been a great public servant and has given himself to his job until he has approached the point of exhaustion. I had hoped that a long rest would restore him to health and enable him to carry on, but his doctor has advised him that he must retire.

"I know of no one who could have done a better job during these hectic years when we have been carrying out the tremendous construction program that the State has undertaken. It is a real blow to lose Charlie and he will be missed in the state service very, very greatly."

In addition to his duties as Director of Public Works, Mr. Purcell held ex officio positions on the Governor's Council, the California Toll Bridge Authority, the State Public Works Board, the California State Conservation Commission, the Board of Public Buildings Reconstruction, the Surplus War Property Procurement Advisory Board, the State Allocation Board, the San Francisco and Los Angeles World Trade Center Authorities, the State Highway Finance Board and was Chairman of the California Highway Commission and the California Water Project Authority. He also was a member of the California Commission on Interstate Cooperation.—*Editor.*

CHARLES H. PURCELL

DURKEE NEW DIRECTOR

On August 3d, Governor Warren appointed Deputy Director Frank B. Durkee to serve as interim director. Mr. Durkee has been deputy director since May, 1948. Prior to that time he had been a member of the legal staff of the department since 1927, having entered state service as editor of *California Highways and Public Works* in November, 1923.

Born in Nebraska

Mr. Purcell was born at North Bend, Nebraska, January 27, 1883, a son of John and Mary (Gillis) Purcell. His paternal grandfather came to the United States from Ireland during the Civil War period, and settled at Freehold, near Albany, New York.

John Purcell, father of Charles Henry, was born in New York but settled later in Nebraska with his three brothers, Thomas, William H. and Charles A. Purcell.

William H. Purcell moved to Chicago, where he engaged in the grain business and became one of the pioneer grain merchants and maltsters. He was one of the first members of the Chicago Board of Trade.

The fourth brother, Charles A. Purcell, went into partnership with William H. and was later the first president of the American Malting Company.

There was one sister, Mary Dowling, who died in Los Angeles, in 1933.

The architect, William Gray Purcell, retired, is a son of the fourth brother, Charles A. Purcell.

Mary (Gillis) Purcell, mother of Charles Henry Purcell, was a daughter of John Gillis of Cape Breton, Nova Scotia, superintendent of a coal mine there.

Mr. Purcell in 1914 married Minnie Pullen, daughter of Andrew Pullen of Portland, Oregon.

Drew Bridges as a Boy

Mr. Purcell attended Stanford University for one year in 1902. The death of his father caused him to go to Chicago, where he took the first job that offered, which happened to be messenger in the Grain Pit.

PURCELL LEAVES IMPRINT FAR BEYOND HIS OWN STATE

RETIREMENT of Mr. C. H. Purcell as Director of Public Works in California means the loss from active service of an outstanding figure in highway improvement in the United States. He has made a record in public service that few can equal. Conspicuous ability as an engineer and administrator has made him a leader since the beginning of the modern highway movement. While his work has been entirely in the western states and notably in California his influence has extended throughout the Nation and to many foreign countries. He has always led in the development of the best practices in the many phases of highway improvement and has had the ability to inspire confidence in the acceptance of these practices. He leaves an imprint on highway engineering and administration that extends far beyond the borders of California.—*Thomas H. MacDonald, Commissioner of Public Roads, Bureau of Public Roads, Washington, D. C.*

As a boy, Mr. Purcell had a fondness for drawing, particularly for making pictures of bridges. He had early set his heart on becoming an engineer, so, after 12 months in Chicago, he gave up his position and enrolled in the University of Nebraska. He was graduated as a civil engineer in 1906.

He gained his first engineering experience during his sophomore and junior years by working Saturdays and during vacations as a draftsman for the Burlington Railroad.

After receiving his diploma, Mr. Purcell became an instrument man and later resident engineer for the Union Pacific in Wyoming. Here he built his first bridge. It was a 200-foot, steel girder, concrete-foundation structure across Bitter Creek. From that time on bridges were his hobby.

Went to Peru

From Wyoming, Mr. Purcell went to Ely, Nevada, where the Guggenheims were building a $17,000,000 smelter. The chief engineer was Tom Cox. He gave young Purcell a job, never dreaming that one day Purcell,

An enduring monument to the genius of C. H. Purcell

as chief engineer of the most famous bridge in all the world, would send for him and place him on his staff of engineers.

About the time that the Guggenheim smelter was completed, American capital was looking with interest toward the mines of South America and Mr. Purcell, with a small company of men who had worked with him at Ely, went to Peru in 1907, where for two and one-half years he acted as principal assistant chief engineer for the Cerro de Pasco mines.

His job in Peru finished, Mr. Purcell returned to New York and then in 1910 came to California and went to Marysville to design steel work for gold dredgers then being built in the Oroville district.

Adventured in Oregon

When Mr. Purcell had been a draftsman for the Burlington Railroad, the president of that corporation, Ralph Budd, had been his friend and hearing that Budd was engaged in construction operations on the Oregon trunk line, Mr. Purcell struck out for Oregon.

His spirits were dampened but his ambition was not lessened when he was offered and took a job as chief engineer of a Columbia River logging railroad. Oregon at this time was building a number of road bridges of iron and steel construction. Mr. Purcell proposed that concrete bridges be built across the smaller streams.

A great hullabaloo was raised by the interests which had a monopoly on selling bridges to Oregon boards of

ENVIABLE REPUTATION

I HAVE KNOWN Charlie Purcell for the past 35 years, first as Bridge Engineer of the Oregon State Highway Department, second as Division Engineer of the U. S. Bureau of Public Roads with headquarters at Portland, then as State Highway Engineer of California, and later as Director of Public Works of the State of California. It is with deep regret that I learn that his health forces him to retire as Director of the California Department of Public Works.

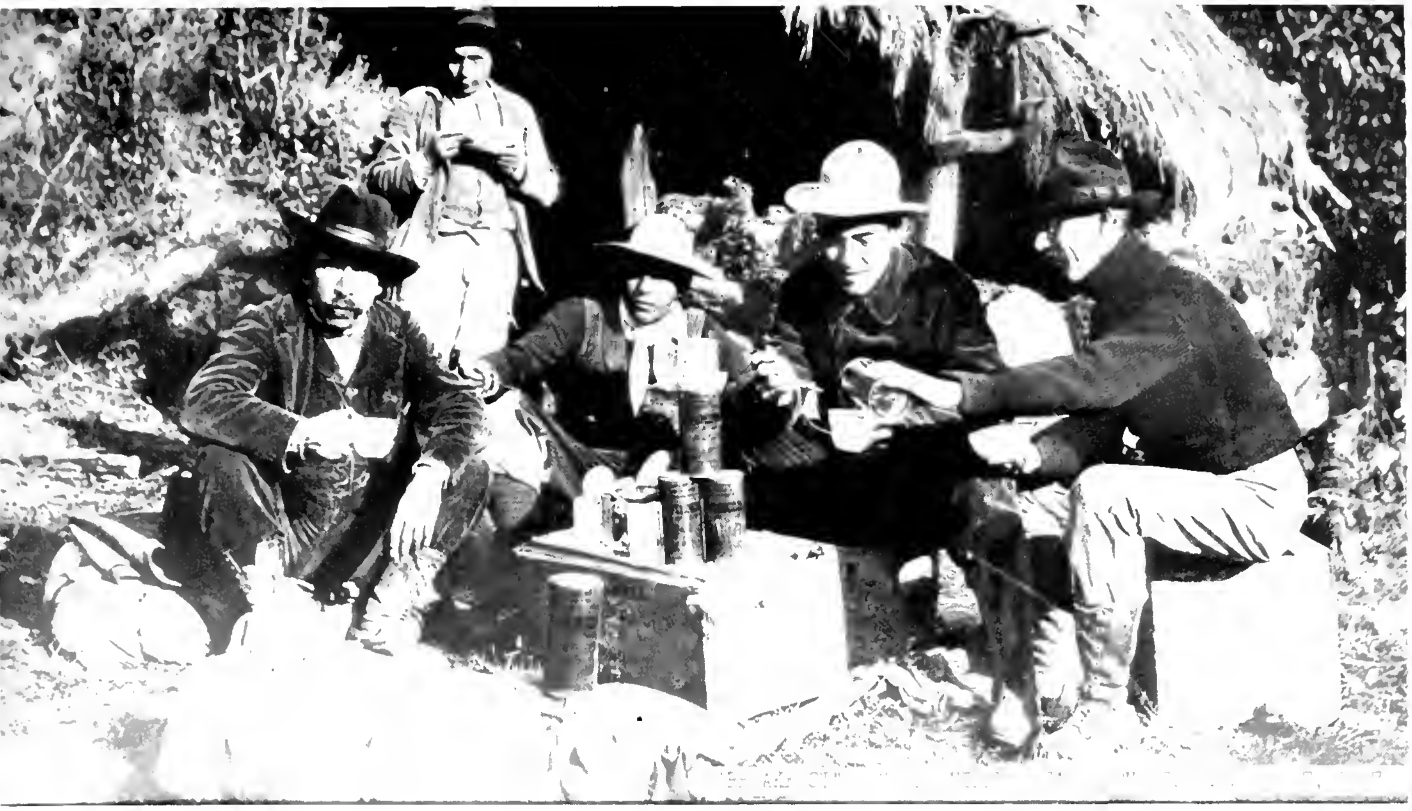
Mr. Purcell has made an enviable reputation as an outstanding engineer. He combines the admirable characteristics of intelligence, professional skill, integrity and courage. His wise counsel will be sorely missed in the American Association of State Highway Officials which he once served as president and for many years as director.—*R. H. Baldock, State Highway Engineer of Oregon.*

TRIBUTE FROM WASHINGTON

Announcement of the retirement of Charlie Purcell from active participation in highway affairs in California will meet with universal regret among hundreds of engineers in the western states who by reason of his long experience and progressive accomplishments have accepted his opinions and advice without question as the wisdom thereof has invariably justified.

None has had the rounded experience and the over-all picture as Purcell, first as Division Engineer for the Bureau of Public Roads at Portland with supervisory functions in Montana, Oregon, Washington and Alaska, and then for many years with the great State of California which developed a marvelous system of highways and world-famed bridges under his direction. We in Washington join a multitude of others in wishing him much happiness in a retirement well earned.

W. A. BUGGE,
Director of Highways,
Olympia, Washington



Tom Cox and his assistant, young Charlie Purcell, have breakfast in Peru during their mining days there in 1907—Cox on right, Purcell seated next to him

pervisors, but Mr. Purcell persisted ıd finally began building concrete ·idges. Those bridges are still in use.

Built Columbia River Highway

As a result of this work, Mr. Purcell as appointed the first Bridge Engi-ɛer for the then newly organized Ore-ɔn State Highway Department, later ɛcoming assistant to the State High-ay Engineer in designing and con-ructing Oregon's first paved highway Jackson County.

Leading citizens of Portland were eaming of a great highway along the ɔlumbia River and they turned to Mr. ırcell to help them build it. Mr. Purcell signed from his state position and be-ıme the Bridge Engineer of the Columbia ver Highway project.

When this task was completed he turned to his post as State Highway ridge Engineer. He remained for a ear and then for two years was bridge ıgineer for the United States Bureau Public Roads, with headquarters in ortland.

In 1920 he was appointed District ngineer of the Bureau of Public Roads charge of District No. 1, embrac-ing Oregon, Washington, Montana, Northern Idaho and Alaska and for seven years supervised the spending of $55,000,000 of federal money on national forest and national park highway and bridge work.

INSPIRING LEADER

IT IS WITH the keenest regret that I learn that Mr. Purcell feels it necessary to resign as a member of the Executive Committee of the American Association of State Highway Officials. So far as I know, there is no one who has contributed more to the organization, progress and strength of AASHO than he. We look to him as an elder statesman. He has always given without stint of his time and great talents to the work of the association.

It is with great reluctance that I accepted Charlie Purcell's resignation as of August 1, 1951.

Mr. Purcell has embodied the spirit, personality, ability and charm of the great engineer. An inspiring leader and executive, and a learned and talented engineer he was for a generation at the top of his profession.

It is a privilege for me to testify to the worth of a great American. Permit me to express the hope that he will have many years of happiness, health and prosperity.—*J. A. Anderson, President, American Association of State Highway Officials.*

Became California Engineer

In February, 1928, Mr. Purcell was appointed State Highway Engineer of California and in five years supervised the construction of $153,000,000 of highways in this State. When Mr. Purcell was offered his California post by Governor C. C. Young and Bert B. Meek, then Director of the Department of Public Works, he was told that he would be expected to make a comprehensive report on state-owned toll bridges, including the proposal to bridge San Francisco Bay.

This was greatly to Mr. Purcell's liking. It was right down his alley. It was in line with his dreams. It was to make him the greatest bridge builder of all time.

Hoover-Young Commission

In October, 1929, the Hoover-Young San Francisco-Oakland Bay Bridge Commission was created and Mr. Purcell be-

LOSS TO AASHO

WHEN NEWS of the retirement of Charlie Purcell from the position of Director of the California Department of Public Works, and membership on the Executive Committee of the American Association of State Highway Officials, reached this office, it left us all with a feeling of depression and personal loss. It has been my privilege to serve as executive secretary of this association for almost eight years and during that time, Mr. Purcell's presence on the Executive Committee has been one of stimulation and encouragement to me and to the staff.

Our feeling of loss is small compared to that which will be felt by the member departments of this association, in whose interest and welfare Mr. Purcell has devoted so much of his time, ability and energy over the years past.

Our records indicate that Mr. Purcell became a member of the Executive Committee of the American Association of State Highway Officials on June 1, 1928, and he has served continuously since that time. He was president of the association in 1937-38. An able engineer and administrator, his valuable counsel will be missed by all of us and his service to highways over the years past has not been limited to the great State of California, but every member department has been a beneficiary. It is such men as Charlie Purcell, both present and past, who have made the association the great and respected organization that it is today.

Believe me, we will miss him in the difficult times that lie ahead of us and we all express the sincere hope that in his retirement from public office he will now find the time and opportunity to relax and enjoy himself, which privilege is so often denied to those men who have devoted their lives to public service.—*Hal H. Hale, Executive Secretary, American Association of State Highway Officials.*

came a member of it and its secretary. He was authorized to make an investigation, traffic survey and prepare a preliminary plan and design, including financing, for a bridge across San Francisco Bay.

STATE ENGINEER PURCELL MERITS PUBLIC RECOGNITION

Honorary degrees conferred by American universities sometimes inspire more of sneers than of cheers.

But nothing but cheers will greet the action of the University of California in conferring the degree of doctor of laws on Charles H. Purcell, State Highway Engineer and Chief Engineer of the San Francisco Bay Bridge.

Not that such recognition will add to the name or the fame of the man receiving it. Both stand imperishable in the great structure with which his name forever will be associated.

But the state university has made a fine gesture that gives public recognition to a big job admirably performed by an able, conscientious, yet unassuming public servant.

It was in 1931 that Purcell was chosen Chief Engineer of the Bay Bridge. And from that day until the structure finally was completed, in the parlance of the street, it was "his baby."

Its construction presented many unusual problems.

It called for engineering feats never before attempted. Had it been built under private contract, the engineer in charge could have retired when the last paint was applied with a handsome personal fortune.

Purcell did the job as an employee of the people of California. And so well did he work that the bridge was completed months before schedule; and for less money than the original estimate.

Nor did one breath of scandal or of criticism attach to the building of the bridge.

What a beautiful thing it is today!

None but the most insensitive can drive across it without feeling that here Titans were at work, here the modern mind created something that expresses at its highest and best the marvelous scientific age in which we live.

California is proud of the bridge.

And she is also proud of her master bridge builder, Charles H. Purcell.—*From Sacramento Bee, March 24, 1937. Similar editorials appeared in many California newspapers.—EDITOR.*

LOSS TO THE STATE

THE RETIREMENT of Charles H. Purcell from public service because of ill health will be a great loss to the State of California.

For Charlie Purcell was one of those individuals too seldom found in public life who blend together rare ability, conscientiousness, high integrity and unlimited devotion to his job.

Purcell's resignation officially is from the post of Director of Public Works. But his duties included membership on numerous important boards and commissions, among them the water project authority, the California Toll Bridge Authority, the California State Conservation Commission, the Governor's council and the State Allocations Board, to mention but a few.

Purcell was the Chief Engineer of the San Francisco-Oakland Bay Bridge during its planning and construction stages and the operation of the structure since its completion has been under his department.

Thus, if it can be said that the bridge is a monument to any single individual that honor rightly should go to him. Not only was he head man in planning and building it but he also was one of the key men in negotiating the financing.

Purcell was no 8 to 5 man but carried his job with him during all his waking hours. As State Highway Engineer, prior to his service on the Bay Bridge, Purcell brought the California road system up to high standards.

He will be missed deeply. But the State wishes him well in his retirement and he can have the satisfaction of knowing that few men leave greater imprints of their service than he does in highways, bridges and public buildings.—*Sacramento Bee, July 28, 1951.*

Mr. Purcell's completed report was adopted by the commission and in January, 1931, he was named Chief Engineer for the Bay Bridge, continuing to administer the duties of his office as State Highway Engineer.

All Californians are familiar with the financial delays and difficulties encountered by Mr. Purcell, the State Admin-

. . . Continued on page 25

South of Border

Governor Warren Loans Highway Engineer to Sonora, Mexico

By F. N. HVEEM *

EARL WARREN — Mexico City, Mex., 28 June

Governor of the State of California, Sacramento, California

I am considering immediate construction of road from Hermosillo to Bahia Kino of 70 miles sandy ground where adequate surfacing materials are scarce. Planning to use recent highway practices for subgrade stabilization with asphalt or cement for which we have no experience in Mexico. Will consider it personal favor if you would authorize the visit of a specialist from your highway department to look over project and make necessary studies together with Mexican engineers. Will be glad to pay expenses and salary. For answer will be at Hotel Del Prado, Mexico City, until Wednesday, July 4th, returning to Hermosillo. Kindest personal regards and thanks in advance.

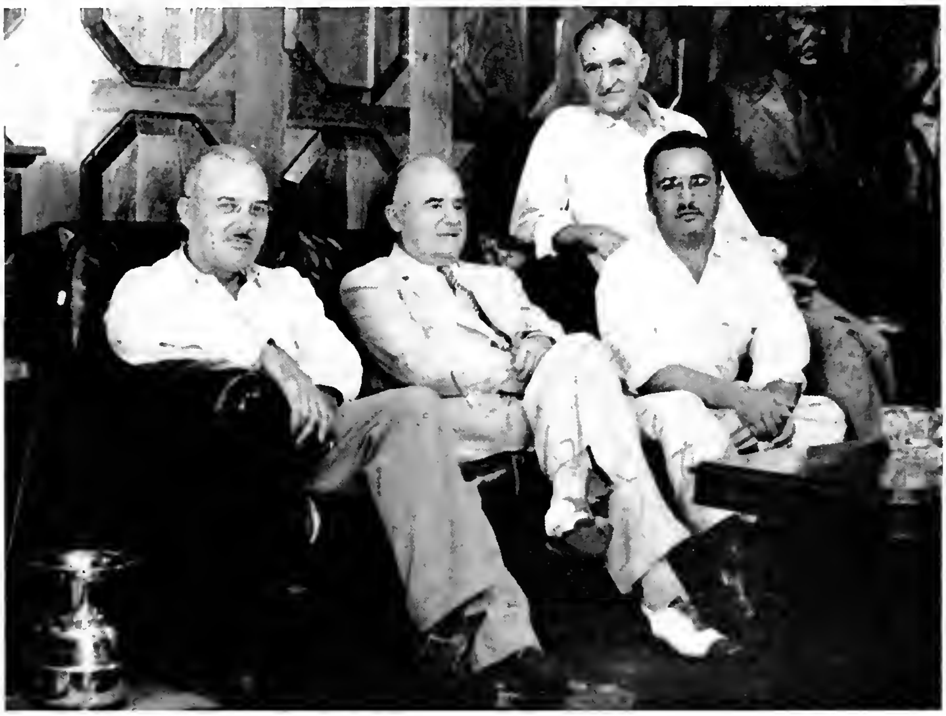
IGNACIO SOTO
Governador del Estado de Sonora

Governor Warren's reply to the above telegram indicated that a California engineer could be made available for a brief period, and after further confirming telegrams, it was agreed that the writer should go to Hermosillo, capital of the State of Sonora, to confer with the Mexican engineers. The State of Sonora adjoins the southerly boundary of Arizona and lies eastward of the Gulf of California on the mainland in northwestern Mexico.

Final authorization was received on Wednesday, July 11th, at 5 p.m. and after rather hurried preparation and somewhat hectic last minute arrangements, the plane was boarded at 7 p.m. Thursday and arrived in Hermosillo at 3.28 a.m. on the morning of Friday, the 13th.

Governor Soto Has Many Friends

Following a call from Governor Soto's office, Senor Alberto O. Montijo, Chief of the Department of Highways, arrived at the hotel in the governor's car and we then proceeded to the Palacio de Govierno which is the Sonoran equivalent of our State Capitol building. After preliminary discussions with Governor Soto, which conversations presented no difficulty as both the governor and Senor Montijo speak excellent English, it was agreed that inspection of the highway should await the arrival of the federal engineer from Mexico City.



Governor Ignacio Soto of Sonora receives F. N. Hveem, California Highway Engineer. LEFT TO RIGHT—Hveem, Governor Soto, Senor Manuel Lopez-Velo, Construction Engineer, Comite de Caminos Vecinales, Mexico City, and Senor Alberto O. Montijo, Chief, Department of Highways, State of Sonora.

I subsequently learned that Governor Soto began his career as an employee of a bank in Douglas, Arizona, later going into business for himself. Governor Soto has many friends in Arizona and other states of the U. S. A. Senor Montijo resided in California for a number of years and received his degree in civil engineering from the University of California. His first job after leaving college was at Pitthree in Shasta County.

The road from Hermosillo to Kino Bay was being planned as a joint project to be financed one-third from federal funds, one-third by the State of Sonora and one-third by taxes or assessments levied upon the properties or individuals served by the improvement. Federal participation in this type of road is under the jurisdiction of the Comite Nacional de Caminos Vecinales, and we were soon notified that

. . . Continued on page 30

* Materials and Research Engineer, California Division of Highways.

Temecula Study

What Happens to the Small Highway Town When By-passed

By FRED O. GIBBONS, Right of Way Agent, District VIII

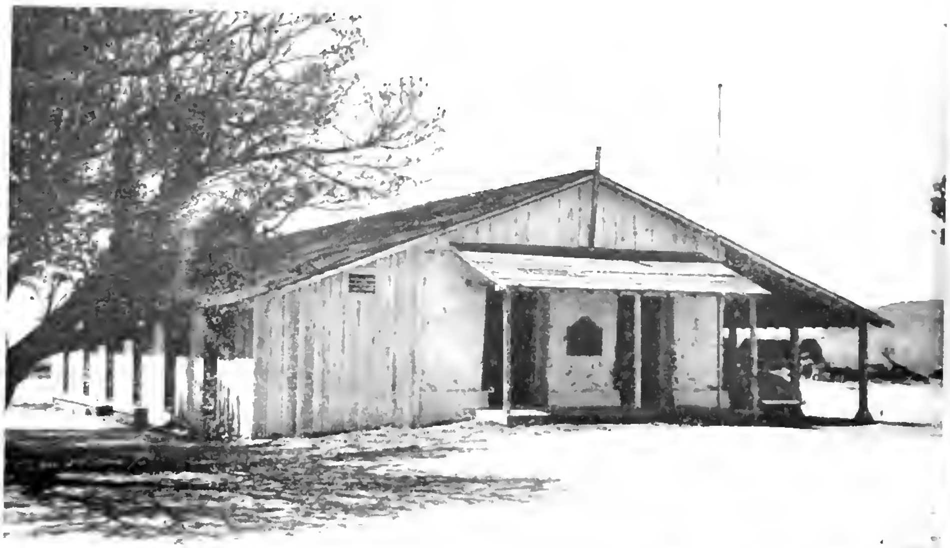
THE FOURTH OF JULY of 1949 was just four days old when the heavy traffic through the town of Temecula in Riverside County was rerouted around the town onto a new section of the freeway on U. S. Highway 395.

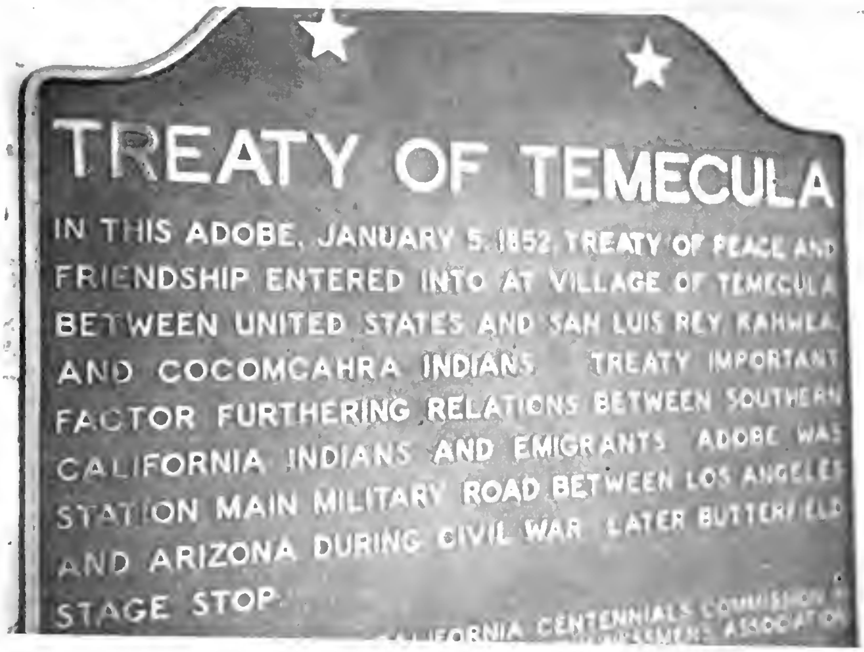
The businessmen of Temecula thought the result would be disastrous. They awaited the expected dire consequence of the by-pass with long and solemn faces, visioning the loss of their incomes, their businesses, and their savings. These men had no false delusions about their small community. They knew that, even before the traffic was diverted, many a motorist had sped down the town's main thoroughfare without even knowing the town's name. Indeed, some travelers had been only vaguely aware of Temecula's very existence as they passed through it. What then, the businesmen asked themselves, would happen when almost all the traffic was removed from town? To find the answer to this question, the Division of Highways recently conducted a study of the Temecula By-pass and this article is a report of what was found.

Interesting History

Temecula, with a population of approximately 500, lies in the San Jacinto Valley between the cities of Escondido and Elsinore, one town out of the many that will be affected by the conversion of U. S. Highway 395 to freeway status from San Diego northerly.

To appreciate Temecula, one must know something of its history. Once the home of Indian tribes, the Temecula Rancho was established by Mission San Luis Rey and was one of the few Mexican land grants made to the Indians. The area surrounding the town is the scene in which the tragic romance between Ramona and Allesandro blossomed forth. A re-enactment of this glorious romance may be seen annually in the play "Ramona" in nearby Hemet.





UPPER—Historic old adobe building where treaty was signed with Indians 100 years ago. LOWER—Plaque placed on building by California Centennials Commission.

Indians Sign Peace at Temecula

Almost 100 years ago the old town of Temecula was chosen as the site for the signing of a treaty of peace between the United States Government and three hostile Indian tribes. The adobe building in which the treaty was signed still stands and is still in use by the cattle ranch on which it is located. In the 1850's, this same adobe building served as a stagecoach stop for the Butterfield Overland Stage Company, a close affiliate of the Wells Fargo Express Company. The tracks left by the

Temecula has no traffic congestion in business district since it was by-passed

ld stages are still visible on the surounding hillsides. They write a story f Indian raids, holdups, accidents, and ardships not known in this modern ge.

Temecula itself attained importance s a railroad stop on the main line beveen San Diego and San Bernardino n the 1880's and 1890's. Great droves f cattle were once brought to the raiload town to be shipped to the Nation's ood centers. However, the railroad acks were washed out in the general oods of 1892 and never replaced. emecula survived the floods to beome one of the many highway towns erving the traveling public between an Diego and Riverside. The cattle inustry is still an important factor in the own's economy as Temecula lies at the esterly end of the Vail Ranch—a vast attle empire of some 80,000 acres.

Answers to Questions

Temecula is an important addition to ur studies for it is representative of the any smaller highway towns which ave already been by-passed and those hich may be by-passed in the future.

To the inhabitants of such a town, e imminence of a by-pass or any diersion of traffic presents a far greater roblem than it would to people living in a larger city. The people of a small highway town believe, and rightly so, that the highway means the life or death of the town. In a city, it may mean only a certain percentage of decrease or increase in business. What, then, are the effects of by-passing the small highway town, which, unlike a city, has almost no local traffic upon which to draw? And, what can a small town do to alleviate any adverse effects that may result from being by-passed?

By interviewing every affected businessman in Temecula and by analyzing the sales volume of each business two years before and approximately two years after the date of the opening of the by-pass it was found that the motorist-catering establishments in Temecula showed no ill effects as a result of being by-passed. The five cafes in Temecula on an average suffered an 18.8 percent decrease in sales volume. However, statistics show that Riverside County's cafes showed an 18.1 percent decrease in the same period, 1948 to 1950. Thus, despite the poor business outlook, apparently there was no damage to cafe business in Temecula as a result of being by-passed.

The average service station in the town of Temecula fared even better than the average station in Riverside County. County stations showed a 27 percent decrease in sales from 1948 to 1950; whereas, Temecula's average station showed only an 8.1 percent decrease in business.

Motel Not Hurt

In the opinion of the manager of Temecula's only motel which was in operation prior to the opening of the by-pass, no ill effects were suffered by the diversion of traffic. As a matter of fact, he feels that the by-pass was a definite benefit to the business.

This opinion is substantiated emphatically by the fact that a new motel was built subsequent to the opening of the by-pass and has enjoyed a lucrative business from the start. The owner of the new motel says that her customers are "tickled to death" for a chance to sleep off the highway.

The remaining businesses in this small highway town number less than half of the total. They include the markets, liquor store, blacksmith shop, et cetera, which do not depend primarily upon highway trade. Unfortunately, there are no appropriate statistics available with which to compare these businesses with similar ones in Riverside County. However, interviews with the respective owners of each of these remaining businesses in Temecula have revealed that the removal of through traffic has had little or no effect upon their trade.

No Ill Effects

From the above comparative statistics and from the reports of the merchants concerned, it has been determined that the town of Temecula suffered no ill effects as a result of being by-passed. The tremendous increase in traffic on the freeway, being approximately 60 percent, has more than offset any damage which might have occurred to business in this small highway town. This fact is made even more startling with the realization that Temecula has lost almost all of its former fishing trade which used to patronize nearby Lake Henshaw. This lake, like so many others in Southern California, is down drastically due to the severe drought of the last few years.

One of three effective community map type signs placed along new freeway to direct motorists to Temecula

Business Pattern

Of considerable interest is the effect of the by-pass on the business pattern of the small community. Just prior to the opening of the by-pass, business was better than average due to the additional trade from the construction crews; but for the first few days after the diversion of traffic, sales slumped badly. The construction workers were gone and the new road was still strange to the old customers. Business increased rapidly, however, as travelers became acquainted with the recently built approaches to the town. Today, the increasing traffic on the better road is increasing sales steadily.

Many businessmen, especially service station operators, reported that their number of sales has decreased somewhat, but that the average amount sold on each individual sale has increased.

Signs

Advertising signs have helped greatly in eliminating any adverse effects of the by-pass. One gas station and cafe operator has increased his sales tremendously by the advantageous use of highway signs.

. . . Continued on page 57

Another view of Temecula business district showing absence of through traffic

Alpine Road

San Mateo County Completes the Third Section of Federal Aid Secondary Route

By HERBERT FRAHM, Resident Engineer

A SECTION of the Alpine Road in San Mateo County which is in the Federal Aid Secondary System was completed on June 7, 1951. This is the third federal aid project that has been completed in San Mateo County. The project realigned 2.57 miles of the Alpine Road which is a section of F. A. S. Route 1048. The limits of the project are between 1.7 miles north of Portola Road and Mayfield Avenue at the San Mateo-Santa Clara county line.*

The first project completed in 1947 realigned 2.883 miles of F. A. S. Route 1052, the limits of which were between the Alameda de las Pulgas, at the westerly city limits of Redwood City, and the Cañada Road, County Road No. 20, F. A. S. Route 1048.

The second project, completed in 1949, realigned 4.693 miles of Canada Road, F. A. S. Route 1048, the limits of which were between 2.5 miles north of Woodside and Ralston Avenue.

The first two projects were completed with the aid of state and federal funds, and the one just completed with the aid of federal funds.

Benefits to Public

The Alpine Road from Mayfield Road to its intersection with the Portola Road provides an important link between commute centers and a rapidly growing rural and residential area. As it existed, the Alpine Road consisted of 16 feet of pavement with substandard alignment, blind curves and a narrow bridge with sharp turns to both approaches. On the realignment of this section a new bridge was constructed across San Francisquito Creek. The section of road that was realigned conformed to the standards of federal aid secondary roads for rolling topography with an average daily traffic count from four hundred to a thousand. The width of the new roadbed is 34 feet with 22 feet of plant-mixed surfacing, and six-foot shoulders. All curves were superelevated in accordance with standards of the Division of Highways.

* This project is a unit of a well-conceived and executed program of improvement upon San Mateo County Federal Aid Secondary Routes 1048 and 1052. This routing traverses Alpine Road, Portola Road, Whiskey Hill Road, Canada Road, and Edgewood Road. The construction work upon this scenic drive is being accomplished with a maximum of utility consistent with preservation and improvement of scenic effect. The painstaking work of the San Mateo County Road Department is appreciated.—*H. B. LaForge, Engineer of Federal Secondary Roads.*

Alpine Road looking east toward Lodero subdivision entrance

Alpine Road looking west across new bridge

The new construction makes it possible for public and commercial vehicles and school busses to travel to commute centers, shopping centers, and schools with a considerable saving of time and a degree of safety not obtainable on the old road.

Engineering and Construction Problems

The design or relocation within the limits of the project resulted in an unbalanced line of 40,000 cubic yards of excess excavated material due to the proximity of the improvements northerly of the San Francisquito Bridge crossing. It was in this section that heavy cuts were encountered. The cost of moving the improvements or homes would not justify a balanced line. The original plan was to dispose of the excess material in an area adjacent to the roadway, but in the progress of construction the Menlo Park Sanitary District made arrangements to haul, at its own expense, all the excess material from the project to its sewage treatment plant site.

The excavation of the sliver cut northerly of San Francisquito Creek Bridge crossing would not have been too difficult except for many rocks located high on the cut. The rocks were up to three feet across, one foot thick, and round as a wagon wheel. Occasionally, in spite of every precaution, one of these rocks would tip on edge and roll. Fortunately, only minor damage to two homes resulted from these "bounders."

Excavation on the sliver cut also filled the old narrow road with rocks and earth, making it necessary to control traffic. Delay was kept to a minimum by the use of a D-8 Caterpillar and Caterpillar blade clearing the road for traffic.

New San Francisquito Bridge

The new bridge across the San Francisquito Creek is a reinforced concrete bridge of symmetrical design, 117 feet long, with three spans supported on concrete piers and abutments. It has a 26-foot clear roadway with a raised safety curb and concrete rail on each side. The bridge was designed by Don S. Wilson, San Mateo County Engineering Road Department, and approved by the Bridge Department of the Division of Highways. Mr. Wilson was able to supervise construction of the bridge and the preliminary part of the road construction as resident engineer before being recalled to active duty with the United States Navy Construction Battalion.

Surfacing for the new road consisted of two inches of dense graded plant-mixed surfacing placed on six inches of crusher run base and seven inches of selected material. Previous projects in San Mateo County have been surfaced with an armor coat, and on this project an armor coat was previously planned. Unfavorable weather conditions for operations of placing an armor coat caused us to change the surfacing to plant mixed. During the paving operations traffic was quite heavy and with the use of a pilot car to control traffic we were able to place the surface with a minimum of lost time, which would have occurred had we placed an armor coat.

Winter Delays Project

Clearing and fence construction were accomplished by San Mateo County forces during the winter before letting the contract. This procedure worked out very well, for in addition to facilitating clearing by permitting winter burning it was possible for the survey crew to set construction stakes with some assurance that they would remain throughout the period of construction.

The project was originally scheduled for completion November 9, 1950, but

. . . Continued on page 58

Escondido Study

City Benefits Materially After Being By-passed by Freeway

By W. STANLEY YOUNG, Headquarters Right of Way Agent

The Escondido study has presented an interesting variation from our previous by-pass studies for three principal reasons:

1. The fact that approximately one-half of the retail businesses in the city are located along the superseded section while the other half are not has made possible a comparison of affected businesses to relatively unaffected businesses in the same community.

2. The traffic count along the main business street, a section of which was formerly the highway, had disclosed a slight increase a year after the by-pass opened, despite through traffic removal.

3. A locally conducted poll of businesses along one section of the superseded highway had indicated opinions that substantial detrimental effects had resulted from through traffic removal. The findings of this poll were opposed by the facts developed by an analysis of all factors involved.

The City of Escondido is located approximately 30 miles northerly from San Diego on one of the State's main north-south routes, and has a population of about 6,600 people, making it the largest by-passed city we have studied.

Highway Use Increased

It is nationally known for its avocado and citrus orchards, and also attracts a considerable number of vacationists because of its delightful climate, picturesque scenery and proximity to many recreational facilities, such as lake and ocean fishing, dude ranches and public parks. There are also several large stock ranches nearby.

Opening of this expressway section of U. S. Highway 395 reduced the travel time between Escondido and San Diego to about 30 minutes. Improvement of this highway between the two cities and also portions northerly from Escondido to Riverside, resulted in a substantial increase in the use of the highway.

This gain in general usage was revealed by the regular Division of Highways traffic count figures at various locations along the highway. The indicated increased usage has amounted to about 35 percent on Sundays and 20 percent on week days in the vicinity of Escondido. Meanwhile, the main north-south routes throughout the State averaged an increase of about 10 percent.

Several miles north of Escondido, traffic along the highway had increased as much as 55 percent on Sundays and 60 percent on week days. These traffic volume gains indicate that both local and tourist use of this route have increased. It is apparent from these figures that U. S. Highway 395 has become increasingly competitive with U. S. Highway 101, the main coastal north-south route.

Traffic Statistics

For a coherent discussion of the effects of the expressway by-pass on Escondido business and property values, it is necessary to refer to the accompanying engineering diagram showing the by-pass in a heavy black line, and the superseded section of highway with a dotted line. Upon opening of the by-pass the traffic count indicated that the principal entrance to the city shifted to Grande Avenue, along which is situated the main business district illustrated in the diagram.

As a result of the shifting of downtown-bound traffic, and the elimination of nonbuying through traffic, the vehicular traffic along Escondido Boulevard, the southerly entrance to the city, had dropped off about 35 percent by a year after the expressway opening.

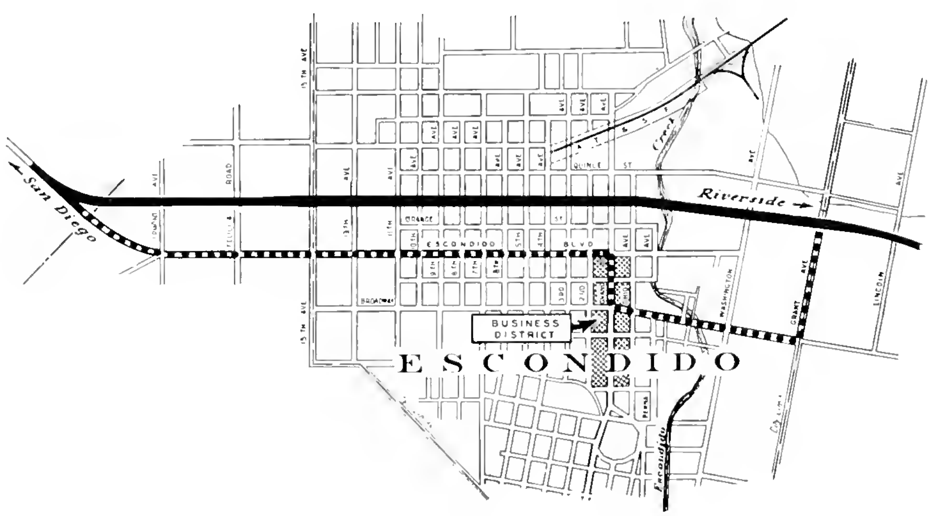
Although traffic along Grande Avenue immediately fell off somewhat after the by-pass was opened, by the midde of 1950, there was actually about a 15 percent greater traffic count on week days and 5 percent more on Sundays than existed prior to the by-pass.

During the year following the expressway opening, vehicular usage of the portion of the superseded highway northerly of Grande Avenue had diminished approximately 50 percent on Sundays and 25 percent on week days.

RETAIL BUSINESS

As was stated near the beginning of this article, merchants along Escondido Boulevard had attempted to make a factual study of the effects the by-pass

Engineering diagram showing expressway by-pass section colored in solid black and superseded route through Escondido in dotted line. Main business district fronting on Grand Avenue is shown by cross notching.



had on the businesses along the boulevard.

The incomplete information obtained in their study indicated that the by-pass was very detrimental to the cafe and service station businesses, which comprise most of the retail outlets along this section. However, our analysis and comparison according to location and type of business of the gross retail sales returns of all businesses in Escondido to San Diego County business averages indicated that the by-pass did not cause a significant reduction in total volume of these businesses along South Escondido Boulevard, although similar businesses along the Grande Avenue portion of the superseded section did enjoy substantial gains not realized in other locations during the period. In this, as in other studies, the businesses catering largely to motorists were considered separately because any effects of the traffic fluctuations could be expected to become immediately apparent in these retail businesses affected.

Business Increases

The comparison of the gross business volume of each of these groups of Escondido businesses, both by-passed and unaffected, to the volume of the same types of business throughout the county is pictured graphically in the accompanying chart. In this comparison we found that the 67 businesses along the by-passed section enjoyed a total volume increase much greater than was the increase of the other 64 Escondido businesses not located along this superseded highway, and was also greater than the San Diego County average gain. These by-passed businesses gained 17.8 percent, while unaffected businesses gained 1.09 percent and San Diego County businesses averaged a 3.2 percent gain.

The cafe and bar business throughout the area dropped off during the year beginning July 1, 1949. However, the nine by-passed cafes had a reduction of only 2.15 percent in total business volume, while unaffected cafes and bars in Escondido had a reduction of 6.2 percent and San Diego County businesses of this type fell off 14.1 percent.

The 18 service stations along the superseded route had an over-all gain of 1.9 percent in retail volume, at the same time the San Diego County service station average was a 23.7 percent decline. We were able to secure the sales volume figures of but one of the four service stations in Escondido not located on the former highway, and therefore could not use these for a comparison.

Aerial photo looking northerly over City of Escondido towards Riverside County line showing expressway by-pass of city. Some of many orchards around Escondido visible in foreground and to right.

Gasoline Sales

The number of gallons of gasoline dispensed by only seven of the service stations in Escondido over the two-year period was secured. These figures indicated an average reduction of 29.38 percent in gallonage dispensed. Five of the service stations were located along the superseded section. One of these service stations which was closed a considerable part of the year after the expressway opened and which had changed tenants several times both before and afterwards, disclosed a 71.9 percent reduction in gallonage. One of the stations enjoyed a 2.19 percent increase in gallonage.

Since these gallonage figures cover only a fraction of the total service stations in Escondido and since there had been an over-all increase in service station retail business, as well as an increase in number of vehicles entering the city, it is not logical to surmise that the expressway by-pass was the principal reason for the gallonage drop-off of the limited number of stations on which figures were available. Rather, the opening of some new stations in the city during the period after the expressway opened and the shifting of customers to other establishments probably accounts for much of the gallonage reduction of these service stations.

It is interesting to note that the average number of gallons sold per month by these seven service stations was only about 7,700 despite the fact that several of the best stations in the city were included. However, the ratio of dollars received in retail purchases on the part of these service stations to the number

of gasoline gallons dispensed was exceptionally high. This may account for the continued operation of some of the unusually large number of service stations serving Escondido.

Other Classifications

In the comparison of the classification "other businesses," the substantial benefits of the highway improvement were very apparent. These businesses along the superseded section, most of which are on the Grande Avenue portion, registered a gain of 20 percent in total volume. Meanwhile, similar businesses located along the portion of Grande Avenue which was not a part of U. S. Highway 395, but in the principal business district, gained only 1.27 percent, and similar San Diego County businesses averaged an increase of 7.3 percent. Please refer to the previously mentioned graphic comparison.

Because of the opinion of adverse effects resulting from the by-pass on the part of Escondido Boulevard merchants, the businesses that were situated on Escondido Boulevard and on a portion of the superseded highway northerly of the main business district, both locations where a severe drop in traffic was registered, have been grouped and the over-all service station and cafe business gain or loss in these locations during the year after the expressway opening has been computed.

Service stations, numbering 16, along these sections had an over-all reduction of 6.3 percent in retail business volume, while the aforementioned county average was a 23.7 percent decline. As stated previously, the total volume of service station business along the by-passed route in Escondido, dominated by the Grande Avenue stations, registered a 1.9 percent gain. Eleven of the service stations continuously in operation during the period of the study suffered declines in business volume, but only one had a more severe drop than the county average.

Summary of Study

The six cafes along these sections (Grande Avenue businesses omitted) fell off 3.8 percent in total volume. As indicated in the graph, the county average in these types of businesses was substantially poorer, being a 14.1 percent reduction in the cafe and bar business. The six cafes also averaged slightly better than the 4.69 percent decline in business registered by the cafe and bar business generally in Escondido, in which are included the businesses never on U. S. 395. However, four of the cafes had business declines and three had greater declines than the county average.

To summarize this phase of our study—the analysis of the business volume of retail establishments through Escondido has disclosed that:

1. Business of each type generally did better along the superseded sections than did the same types of businesses never situated directly on U. S. Highway 395 and also better than the San Diego County average.

2. Service stations and cafes along the superseded sections where the traffic reduction wos greatest had a better average than the caunty but these service stations fared poorer than Escondido service stations generally.

3. The highway improvement was especially beneficial to the business volume of establishments along the two-block portion of the superseded section of Grande Avenue.

4. There was an 11.7 percent increase in total retail business volume in Escondido the year after the expressway opened exclusive of all chain firms and businesses having two or more outlets in the county. The dollar amount of this increase was approximately one and one-quarter millions.

Some of the items which suggest themselves as reasons for the difference in the findings of the local business study and our analysis of the by-pass effects along

Looking south along the superseded portion of Escondido Boulevard showing some of businesses which are interspersed along one mile of street within city

certain portions of the superseded highway section are as follows:

1. Individual merchants were unable to separate the effects of through traffic elimination from the effects of the construction of new businesses and the shifting of customers from one business to another along the same street. This segregation was not necessary in our analysis because general by-pass effects on business potential are reflected only in the total volume of all similar businesses along the same section.

2. The general downward trend in the cafe and service station business throughout the county was not taken into account.

3. An element of the rationalizing encountered in some of our previous studies wherein the comparison used was "the amount of business which would have developed if the highway had not been realigned and use of the facility had increased as it did after the improvement" may have entered into some of the individual opinions rendered.

Intersection of Grand Avenue, principal business street, with expressway. The substantial gain in values was along the section of Grand Avenue partly visible in right center of picture.

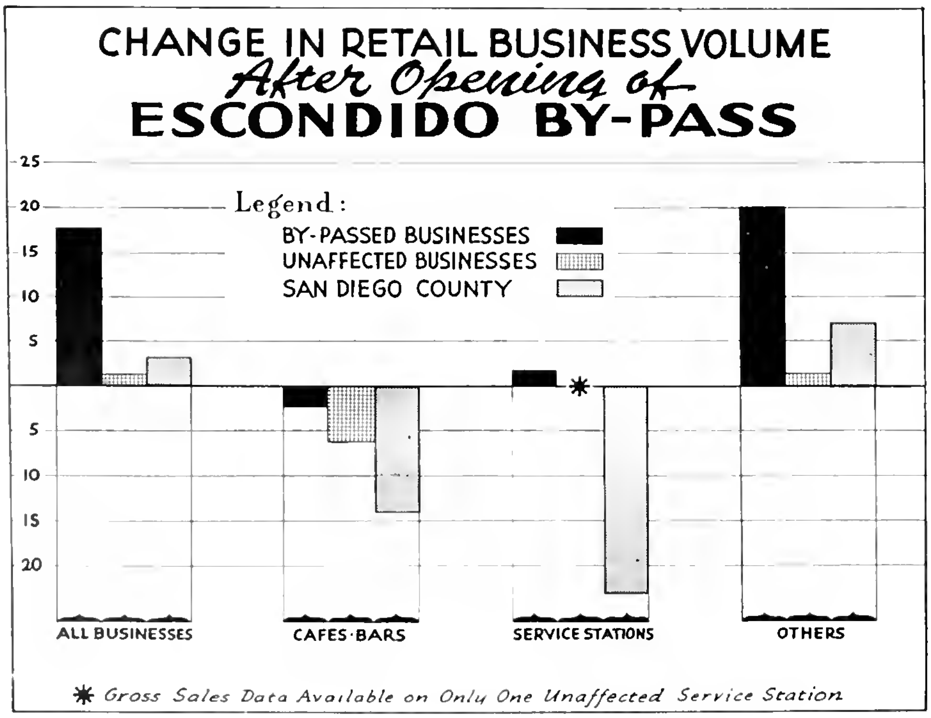
REAL ESTATE

In studying all of the 80 real estate transactions in Escondido along the superseded section and on Grande Avenue in the vicinity of the highway since 1945, we found that the property values have been continuously on the increase. This was true along all sections of the superseded route, although the most substantial gains in value as well as the greatest realty activity were registered along Grande Avenue between the expressway and South Escondido Boulevard.

The extremes in vacant property selling prices during the five years following World War II along Grande Avenue are indicative of the rapid rise in values there. In 1945 vacant property along this section had sold for as low as $20 per front foot. In the latter part of 1949 one vacant property was sold for $315 per front foot.

Along Grande Avenue, between the expressway and the main business district, 11 properties were sold two or more times between 1945 and 1950. In each case the succeeding sale was considerably above the preceding one. A few of these properties recently sold for four times as much as the price of the same property shortly after World War II. Several properties sold for about twice as much after construction of the expressway as the previous sale.

Graphic comparison of the retail volume of various types of businesses along the superseded portion of U. S. Highway 395 through Escondido to other Escondido businesses not situated along this route and to similar San Diego County businesses during the same period



Increase in Building

There has also been a substantial increase in business building along Grande Avenue just east of the expressway in the past two years. At the present rate of growth Grande Avenue will soon be built up continuously with commercial establishments. Patronage for these new businesses comes from areas brought nearer in driving time by the highway improvement and from the rapidly expanding Escondido community population.

Real estate activity along the superseded sections north and south of Grande Avenue in Escondido has been considerably slower than on the main business street. However, the limited number of sales which have occurred did not indicate any decline in values

... Continued on page 17

Busy Day

Highway Commissioners Break Ground For Two Major Freeway Projects in South

By R. C. KENNEDY, Secretary, California Highway Commission

On Wednesday, June 27, 1951, three members of the California Highway Commission put in a real busy day.

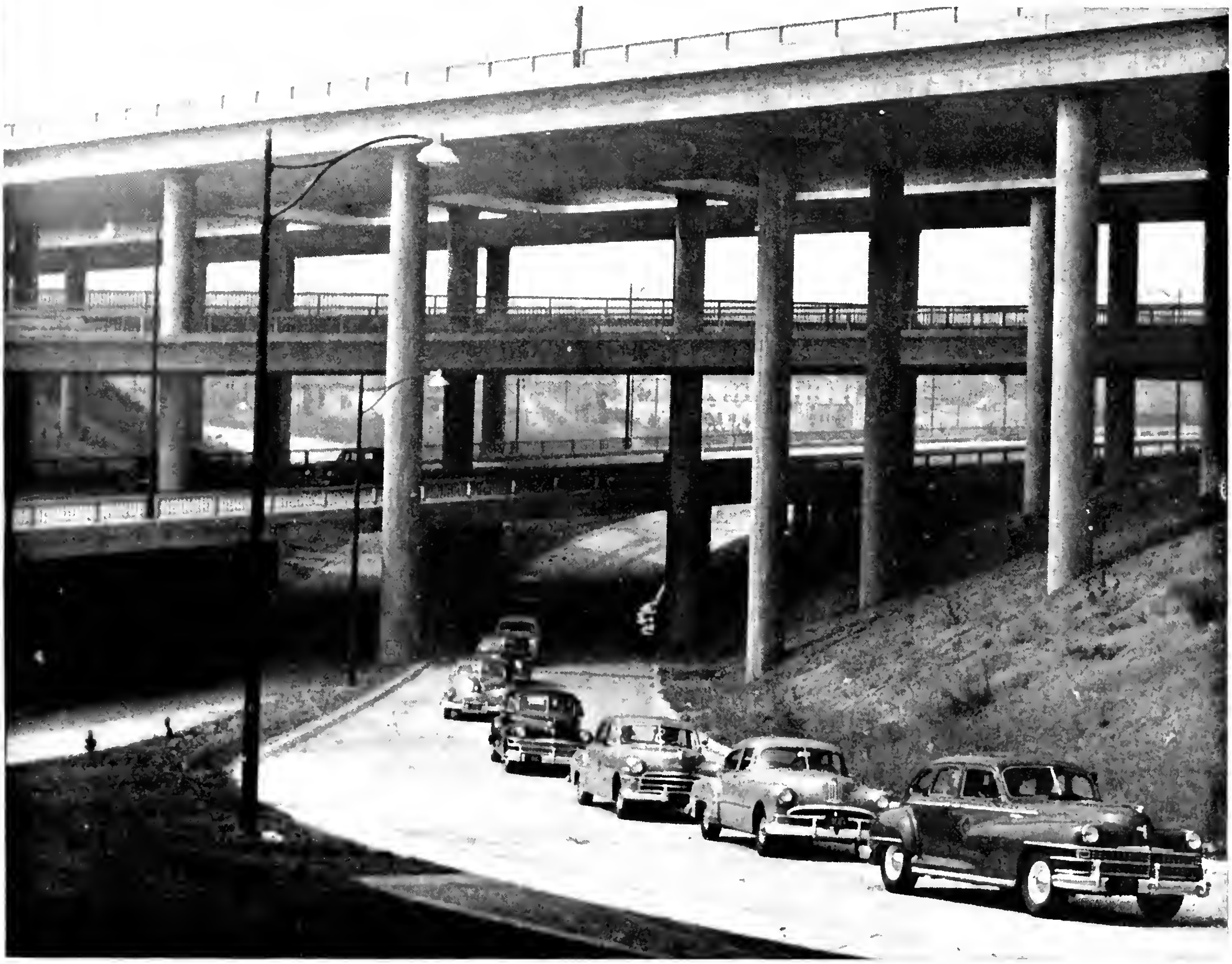
Harrison R. Baker, James A. Guthrie and Chester A. Warlow had consented to go on a tour of Southern California sponsored by the California State Chamber of Commerce. Meetings had been scheduled from Monday through Thursday at various places from Santa Maria to Riverside.

On Wednesday morning the commissioners, state highway engineers and the group from the State Chamber of Commerce met on Grand Avenue, Los Angeles, back of the Biltmore Hotel. Here the caravan was formed and started on its way, led by Paul O. Harding, Assistant State Highway Engineer in Charge of Metropolitan District VII. Finally, the caravan reached the lower level of the four-level distribution structure in the heart of Los Angeles.

Ground Broken

Here a stop was made while ground was officially broken for the start of a portion of the Harbor Freeway between Temple Street and Fourth Street. This short section will connect the Arroyo Parkway directly with the Harbor Freeway, now being constructed as far as Olympic Boulevard.

Autos passing under four-level grade separation structure using the lowest level for first time



Official group at ground-breaking ceremonies. LEFT TO RIGHT—Assistant State Highway Engineer J. W. Vickrey, Commissioner Chester W. Warlow, Assistant State Highway Engineer Paul O. Harding, Commissioners James A. Guthrie and Harrison R. Baker, and Ken Kendrick, California State Chamber of Commerce.

A part of the ground-breaking ceremonies consisted of the pushing in of enough dirt to provide a ramp connection between the Harbor Freeway and the Temple Street bridge so that the cars in the caravan could drive over this structure and pass under the four-level grade separation structure, utilizing the lowest level that will provide the traffic interchange for westbound traffic between the Harbor Freeway and the Hollywood Freeway.

River Freeway Started

This occasion was momentous because it was the first time that passenger automobiles had utilized the lower level of the four-level grade separation interchange in just this manner, actually driving in the direction intended over the roadway that has been provided to connect the Harbor Freeway with the Hollywood Freeway.

When the ceremonies were completed, the caravan was led out the Santa Ana Freeway to Lakewood Avenue; south on Lakewood to the Pacific Coast Highway in Long Beach; west on the Pacific Coast Highway to just west of the bridge spanning the Los Angeles River.

Here the official ground-breaking ceremonies for the start of construction on the Los Angeles River Freeway from Pacific Coast Highway to 223d Street were held.

This contract was awarded to the Griffith Co. and amounts to $1,507,-323.30. It is for 2.5 miles and includes grading, paving and structure.

Cooperation

At the ground-breaking ceremonies the principal speaker for the Highway

. . . Continued on page 62

Groundbreaking for Los Angeles River Freeway. LEFT TO RIGHT—Walter Haverkorst, President of Long Beach Chamber of Commerce; Commissioner Baker, Assemblyman William Grant and Mayor Burton W. Chace, Long Beach.

OUR MILLIONTH VICTIM

By COL. ROBERT C. F. GOETZ, Editor-in-Chief, Traffic Quarterly

THIS is the year when someone will become the millionth victim of fatal motor accidents in the United States. This is our record for a generation—nearly three times as many killed by motor cars in the last 50 years as were killed in action in all our wars in the 175 years of our history. It is a shocking record, shocking enough to awaken a vigilant and sympathetic people.

It has not done so. It has not awakened us, though citizens have daily commented and speculated upon it, and writers have strained their vocabularies to arouse us to effective action.

These significant records, scrupulously compiled, are subject to many forms of statistical comparison. But even a cursory examination reveals many reasons for annual repetition of motor vehicle casualties and their growing seriousness.

Our repeated failures to face the problem realistically have reached a degree of indifference. And the indifference has been a national disgrace for a quarter of a century. No other problem of the same importance to our life and security has gone so long with so little correction.

These statements are made with full knowledge of minor variations over the long period of years and of those arguments based mainly on laws of chance and inevitability. So long as we leave undone those things that so obviously ought to have been done, we practice defeatism and decry the consequences.

Any approach to a solution must curtail those unnecessary accidents due to causes subject to correction. To achieve this end, definite and positive control measures should be rigidly enforced.

Every community has contributed to the problem. Every community has a moral obligation to correct it.

It is unthinkable that so many incompetent and dangerous drivers have been qualified and privileged to drive by official state agencies. The tendency to neglect minor offenses leads to carelessness, serious accidents and a flouting of law.

Driving a car is a serious business, but many drivers do not so regard it. On their feet they are one thing, in their cars quite another.

Any form of industry or national activity operated on similar loose and neglectful principles would quickly founder. The initiation of corrective measures must come from higher-ups. It is their serious responsibility and moral duty.

Reasonable regulations, enforcement with sufficient emphasis on minor violations and stern judicial support will quickly bring the driving public to a sane realization of their obligations.

The editorial by Colonel Goetz indicates that every community contributes to the traffic accident problem and has an obligation to correct it. This can be applied to states as well as communities. California is making a determined effort to reduce accidents. Governor Warren's Traffic Safety Conference, held in Sacramento last December, was attended by more than 500 persons.

The annual Inventory of Traffic and Safety Activities conducted by the National Safety Council ranks California first in a group of the eight largest states for achievements in the year 1950 in traffic and highway engineering, traffic legislation, and traffic law enforcement, a tie with Ohio for first place in public information, and second in driver licensing.

Although California ranks high in the national safety contest in the important points mentioned by Colonel Goetz, the number of traffic accidents is appalling. Even greater effort is necessary in traffic safety activities. Every driver must be made to realize that "driving a car is a serious business."—Editor.

Escondido Study

Continued from page 14 . . .

after the elimination of most through traffic.

Since there are more than two miles of frontage along South Escondido Boulevard and Broadway north of Grande Avenue, the abundance of available land had maintained values for either commercial or residential uses at about the same level. This level has risen steadily with property values generally in the city. Commercial growth in the forms of new businesses and expansion of existing facilities has apparently not been retarded along these by-passed sections. However, the tendency has been for these businesses to solicit greater local patronage.

CONCLUSIONS

Our analyses of the retail sales figures of Escondido businesses and the real estate transactions along the by-passed sections conclusively pointed out that the highway improvement has been a substantial benefit to Escondido. Obviously it is impossible as well as unimportant to segregate the actual by-pass effects from the effects of the general highway improvement.

The increased use of the highway in the vicinity and the greater number of vehicles now entering the city as well as the 11.7 percent gain in over-all retail business volume in Escondido indicates the growth taking place in the area since the construction of the expressway. Undoubtedly the highway improvement was one of the major contributing factors.

Concerning the sections of the superseded route where there was a substantial decline in traffic after the by-pass opening, it is evident that there was not a reduction in amount of business potential following the by-pass installation but rather a change in the nature of the potential. The result was a betterment to some businesses to the detriment of other merchandising establishments, especially those which were catering almost entirely to highway patronage.

Following in line with the accelerated activity in Escondido after the highway improvement, the ensuing rise of property values throughout the community was to be expected.

As has been our experience in previous studies, the retail sales analysis of Escondido businesses reiterated that it is impossible to estimate accurately the effects of any single incident on an individual business without having available the volume figures of all local competitors as well as a suitable yardstick to eliminate the necessity for consideration of general economic fluctuations.

Arnold Freeway

Another Link of Industrial Highway in Contra Costa Open

By R. C. KENNEDY, Secretary, California Highway Commission

A LONG AWAITED development of the freeway system of Contra Costa County was consumated on Tuesday, July 17th. Very simple ceremonies were held at the Port Chicago end of the construction by having Ralph R. Arnold, for whom the highway is named, cut a ribbon signifying the opening of the 4½-mile section to traffic. Immediately following the cutting of the ribbon, a caravan was formed which traversed the entire length of the new construction and ended at the Villa Cafe in Pittsburg. A luncheon sponsored by the Pittsburg Industrial Association was held to formerly celebrate the completion of this section of highway.

This 4½-mile section of freeway between Port Chicago Road and Pittsburg was constructed by Parish Brothers of Benecia at a construction cost of $850,000.

The right of way for this unit is generally 166 feet in width and cost $312,000, including clearing of improvements and utilities, making a total cost of $1,162,000, or approximately $258,000 per mile. This freeway consists of a four-lane divided roadway with a separation structure over the old highway near the west end of the project.

Pedestrian Underpass

A pedestrian underpass is provided across the freeway at the Ambrose Park recreational area. Frontage roads were provided where required by local traffic in the vicinity of Bailey Road, Bella Vista Avenue and Railroad Avenue.

The geometric design of the roadway is two 12-foot lanes in each direction, separated by a division strip of variable width, with a minimum of six-foot curbed section to a maximum of 32 feet in the uncurbed portion.

The structural design is a four-inch plant-mixed surface over 20 inches of imported base material, the top eight inches of which is cement treated.

Illumination is provided at important road intersections and in the pedestrian underpass.

This section of roadway took about 16 months to complete and was financed from State Gas Tax and Federal Aid Funds.

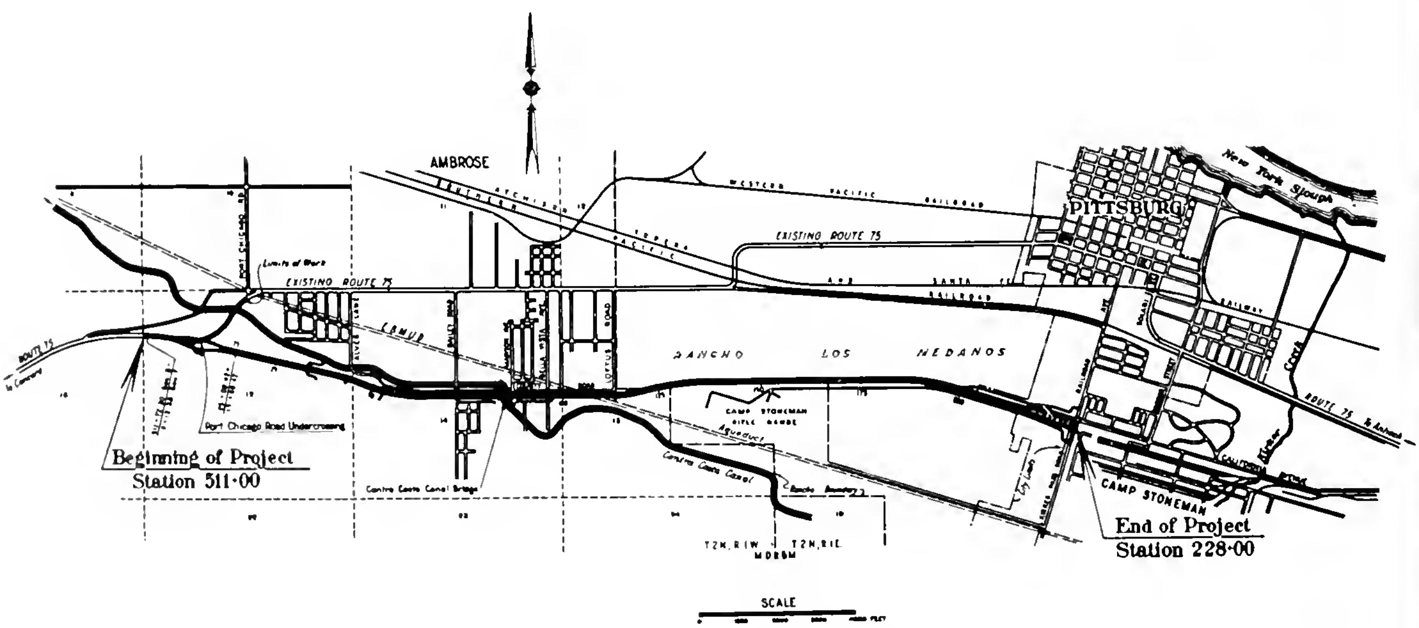
The accompanying map shows the relation of the new freeway to the old road and adjacent communities.

All Industries Represented

All the industries of eastern Contra Costa County were well represented by members of the industrial association.

Joseph L. Judson, President of the Contra Costa County Development Association, was master of ceremonies. His first introduction was of Jack Cummings, Chairman of the Board of Supervisors of Contra Costa County. Cummings welcomed the engineers and representatives of the Highway Com-

In Contra Costa County, between Port Chicago Road and Pittsburg



Length of Project 23,659.97 feet 4.481 miles

UPPER—Scene at dedication at Port Chicago end of freeway showing separation structure. Eastbound traffic uses lanes on left, westbound traffic elevated lanes on right. CENTER—Caravan goes over new highway. BOTTOM—New highway looking west.

Joe Arnold cuts ribbon opening new section of Arnold Freeway. LEFT TO RIGHT—H. L. Cummings, Col. R. D. Boerem, Col. Jno. H. Skeggs, Arnold, Highway Commissioner Chester H. Warlow, J. L. Judson, Deputy State Highway Engineer R. M. Gillis.

mission and hoped that it wouldn't be too long before he could welcome them again under similar circumstances.

Supervisor Buchanan was next introduced, as this new construction is in his district. He told of the plans of the county for the coming year, as far as its road program was concerned, and lauded the Division of Highways on the amicable relations they had always had with their representatives.

Joe McCulloch of the Columbia Steel Corporation, represented the Pittsburg Industrial Association and he, too, welcomed everybody to Pittsburg.

As Deputy Commander of Camp Stoneman, Col. R. D. Boerem said he was sure that the new highway would relieve much congestion to and from his station and hoped that the Highway Commission could see fit to continue the road so as to make it even better. Col. C. C. Williams, Commander of the air forces at Camp Stoneman, echoed the sentiments of Col. Boerem.

Robert L. Condon, Assemblyman of the Tenth District, hoped that this new road was only the beginning. He stated that Contra Costa County is now the second industrial county in the State of California and its needs for more roads were becoming more apparent each day.

Senator George Miller of the Seventeenth District, thanked the Highway Commission for everything it has done. He stated that if the present growth of Contra Costa County continued, the needs for more highways would grow with them. He wants more industries in Contra Costa County, and to get more industries, more and better highways will be needed. He sees in his mind's eye, a highway from the new Richmond-San Rafael Bridge, traversing the county in an east and west direction, and another highway from the future Martinez-Benicia Bridge, traversing the county north and south.

Col. John H. Skeggs, Assistant State Highway Engineer, was called upon and merely thanked everybody for being at the celebration and hoped that he would attend many more.

A. L. Weymouth, District Engineer, stated that he would like to see the commission get more money so it could build more highways and so that so many people wouldn't complain.

Chester A. Warlow, Highway Commissioner, stated that the commission was well aware of everything that pertains to the troubles of Contra Costa County. He stated that any highway problem can be solved if you have money enough to build it.

According to Warlow, who read from statistics, the commission has spent $8,000,000 in Contra Costa County in the past six years, but it has not made a dent in the critical deficiencies as the last report showed that there was an $82,000,000 deficiency in Contra Costa County. This critical deficiency, he said, has been caused by the rapid population and automobile growth in Contra Costa County, as well as in the entire State. According to the present rate that highways are being built, with the present money available, it will take some 30 years to remove the critical deficiencies in Contra Costa alone.

Joseph L. Judson then paid special tribute to Ralph R. Arnold, who was at one time County Surveyor for Contra Costa County. According to Judson, the idea of the Arnold Industrial Highway was thought of 25 years ago, and the idea was promulgated by Arnold at that time. This day marked the realization of part of Arnold's dream.

Rynard Bergman Retires After 32 Years of Service

The division of highways is a relatively large organization with about 8,000 employees, nearly 3,000 of whom are engineers. During the nearly 40 years of the department's growth there have been many engineers who have given years of efficient and faithful service to the development of California State highways. Included in this group was Rynard A. Bergman, who has retired from state service just 32 years after he first went to work for the old California Highway Commission on December 18, 1918. On one or two occasions Bergman left state employment for other engineering work but each time the fascination of highway work called him back so that within the 32 years, he worked for the state highway organization a total of over 31 years.

Saw Army Service

Born in Minneapolis in 1891, "Bergie" received his engineering education at the University of Washington and began his work as an engineer in California on field parties and at the drafting table with the Orange County Road Department. He also worked on road surveys and construction for Riverside and Sacramento Counties. In 1918 Bergman enlisted in the Army and served three months in officers training school. Upon his discharge, he entered the employ of the California Highway Commission as instrument man and assistant resident engineer.

Prior to 1922 Bergman left California State highway employment to work for the Oregon Highway Commission, the reclamation district at Colusa, and to engage in the logging industry with his father near Seattle. Back in California, he was a draftsman and resident engineer for District I of the California Highway Commission. Following that he worked continuously until his retirement in Districts III, VIII, IX and XI and with the office engineer's organization in headquarters.

. . . Continued on page 53

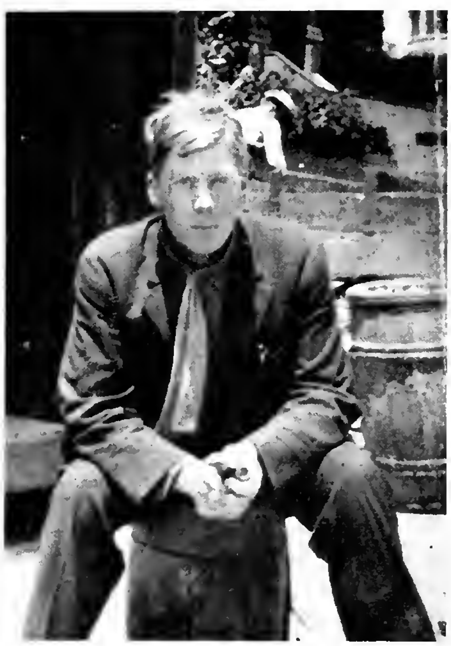
ASSISTANT STATE ENGINEER P. H. VAN ETTEN IS RETIRED

Assistant State Engineer P. H. Van Etten retired from his position with the State Division of Water Resources on June 15th after 22 years of service with the State. Van Etten became an employee of the Division of Water Resources in 1929 as senior hydraulic engineer. He subsequently held the posts of principal and supervising hydraulic engineers.

Van Etten has been in charge of the division's surveys of potential water projects throughout the State, including studies of California's water needs which led to the proposed Feather River Project. He worked on the early studies which were the basis for the Central Valley Project, and bringing a water supply from the Colorado River to San Diego.

Prior to his state service Van Etten worked for the Bay City Water Company and in 1914 designed and built the South San Joaquin Irrigation District's canal system. He was subsequently resident engineer of the South San Joaquin Farm Lands Company in charge of design and construction of the irrigation and reclamation system for 2,000 acres belonging to that company.

P. H. VAN ETTEN—1951



P. H. VAN ETTEN—1909

Van Etten was a first lieutenant during World War I in the 23d Engineers. He spent fifteen months overseas with the A. E. F. Returning from service he spent four years as superintendent for various construction companies building docks and industrial buildings in the Tacoma, Washington, area. From 1923 until 1929 he was superintendent of construction on a number of sewer construction jobs in Southern California.

After attending schools in Dover, New Jersey, where he was born, Van Etten came to California in 1905 to attend Stanford University. He graduated with a mechanical engineering degree in 1909. Van Etten married Miss Mae Kelliher, a teacher in Escalon, in 1915. They will make their home in Stockton.

Warthan Canyon

Traffic Hazards Removed From Coalinga-San Lucas Highway

By HARVEY W. PORTER, Associate Highway Engineer

ON JULY 14, 1951, the Coalinga Chamber of Commerce officially celebrated the opening of the latest improvement of State Sign Route 198 in Warthan Canyon, between Coalinga and San Lucas. Contract 51-6TC5, with John F. Blakemore as contractor, was started November 14, 1950, and completed June 26, 1951, some 2½ months ahead of schedule

Ceremonies Held

Ceremonies were held 13 miles west of Coalinga, at the junction of the road leading to Coalinga Memorial Springs.

R. B. Branum, Chairman of the Highway Committee of the Coalinga Chamber of Commerce, introduced five of the real oldtimers who have been working for years on this particular road project. Branum welcomed the representatives of the Division of Highways and the Highway Commission, and expressed the hope that sometime in the not too far distant future more money could be allotted for the continuation of the improvements on this highway.

The only speaker besides Branum was Chester A. Warlow, a member of the California Highway Commission, residing in Fresno. Warlow told of the rising costs of highway construction and the static condition of the income that the Highway Commission had to deal with. He told of the myriad miles of our highway system which were in need of improvement and stressed the fact that the commission is doing the very best job it could with the money it had available.

Immediately following the ceremonies, a caravan was formed to Lone Pine Resort, where a barbecue lunch was served to an invited list of guests.

The Warthan Canyon project was set up to eliminate several crossings of Warthan Creek and several dangerous curves in the winding, existing road. Creek crossings in this mountainous area have been very troublesome in the past due to the small capacity drainage facilities on the old road and the flash floods that are prevalent in this locality.

At Warthan Canyon dedication. LEFT TO RIGHT—Ed. Waite, Construction Engineer, and District Engineer E. T. Scott, Fresno; Highway Commissioner Chester H. Warlow, Deputy Director of Public Works Frank B. Durkee, and R. C. Kennedy, Secretary of Highway Commission.

The work was done in two locations, the major section starting 13 miles west of Coalinga at the crossing of Hot Springs Canyon Creek and extending westerly over new alignment for 3.2 miles. The second section of the work began 5.5 miles farther west at Lone Pine Inn and extended for 0.2 miles to the junction of Warthan Creek with Coal Creek, 1.8 miles east of the Monterey-Fresno County line.

Creek Crossings Eliminated

A reinforced concrete slab bridge 88 feet long consisting of three spans supported on reinforced concrete bents was built across Hot Springs Canyon Creek to replace an often washed out 20-foot timber bridge. As part of the improvement, the modern design standards used in the location was able to establish one tangent 7,600 feet long which replaced two crossings of Warthan Creek and two miles of winding road. Four additional crossings of Warthan Creek were eliminated by the construction of two major channel changes of 10,000 cubic yards each, one on each of the two sections of the project.

The project was planned with a balance section between the cuts and fills. There was 275,000 cubic yards of material to be excavated from the cuts and channel changes with 1,700,000 station yards of overhaul necessary to complete the embankments. One mile from the easterly end of the project at engineer's Station 76+00, a thorough cut 700 feet long and 75 feet deep contained a total of 106,000 cubic yards. At this location, the alignment intersected a ridge which showed outcroppings of sandstone. Another sandstone outcropping was found along a 90-foot sidehill cut 2.1 miles from the easterly end of the project at Station 15+00.

Compaction Factor

From the materials available, the structural design of the roadbed was set up to place the embankments to within two feet of grade with a minimum relative compaction of 85 percent without the addition of water. Standard methods of compaction were

Three views of new Warthan Canyon highway. Lower picture shows official dedication party moving over newly completed section.

used above the plane two feet below grade. Twenty inches of select material obtained from the two sandstone cuts was to be placed as a cover over the structurally weaker materials predominating over the ramainder of the job. The top four inches of this sandstone was to receive a bituminous surface treatment providing two 11-foot lanes with two-foot shoulders on each side. Berms or gutters were to be constructed throughout.

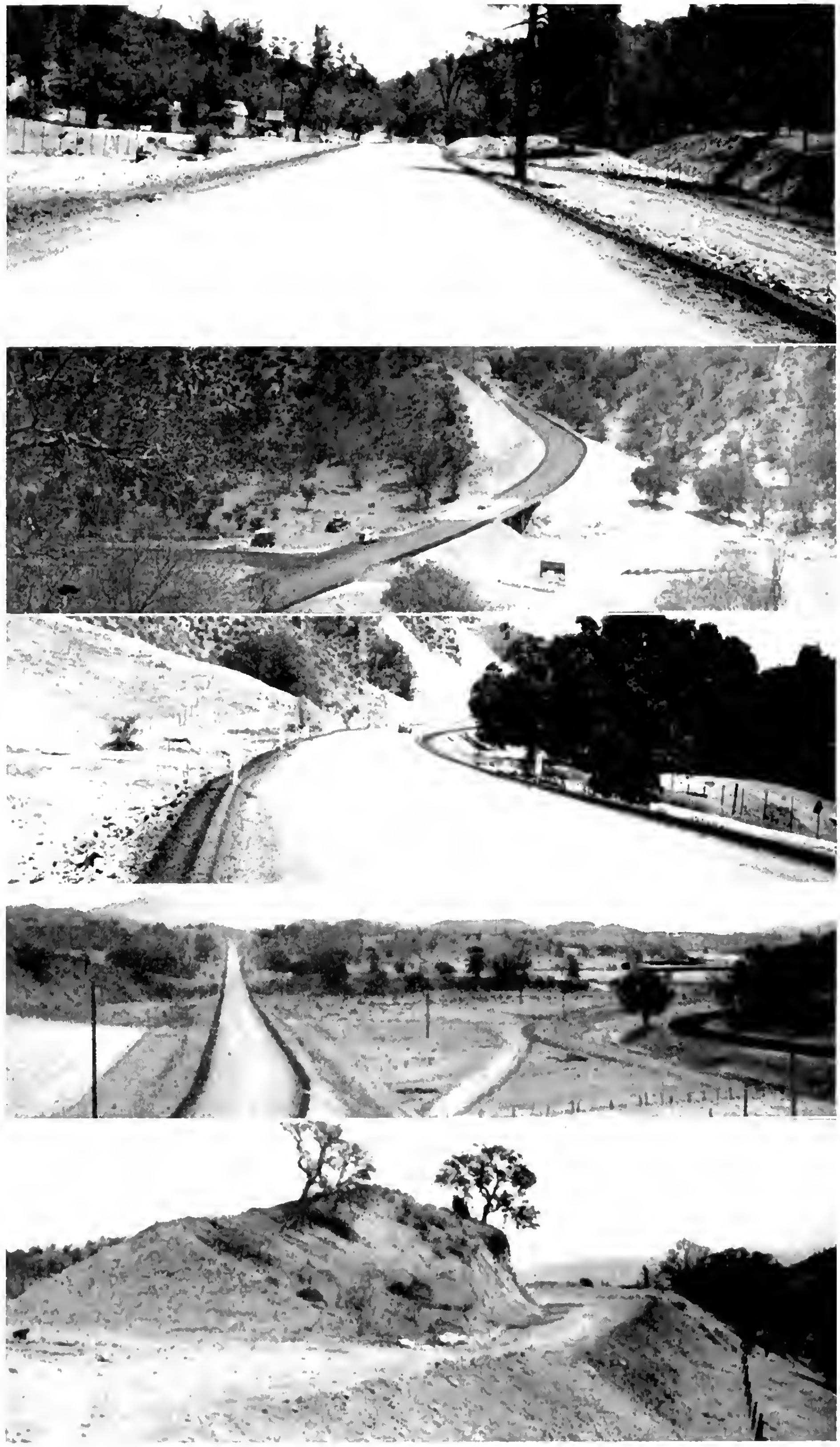
The contractor chose to use 12 cubic yards Tournapulls to do all of the excavation. Pioneering of the roadway section was accomplished with D-8 Caterpillar dozers and Caterpillar No. 12 power blades. Using up to six Tournapulls, the contractor moved a maximum of 8,000 cubic yards of material during a nine-hour shift. The 85 percent minimum compaction was easily obtained by routing the "pulls" over the entire fill width and supplementing at times with sheepfoot rolling.

Drill Rig Used

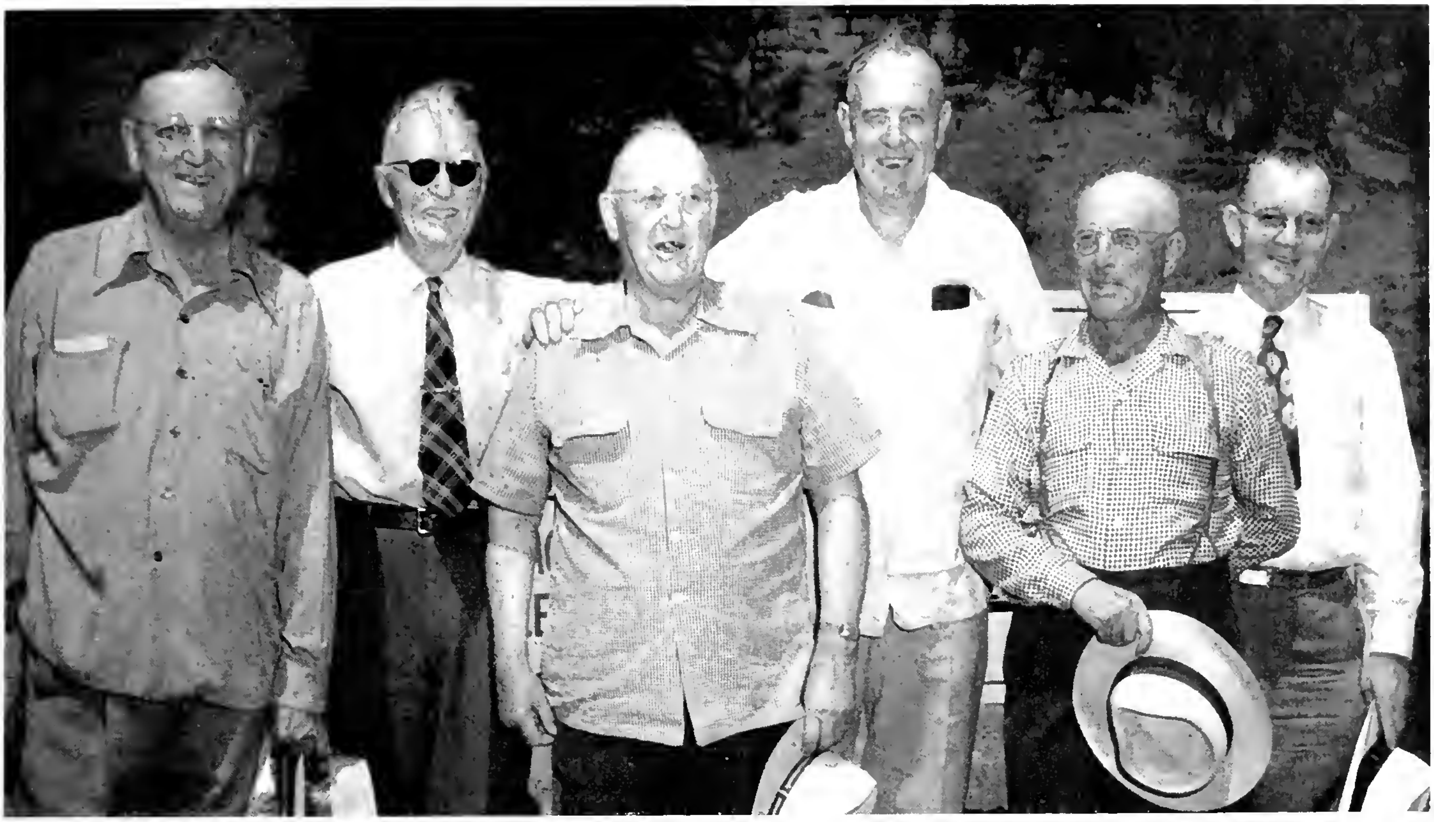
As the "big cut" at Station 76+00 was opened up, the district drill rig was brought on the job and samples were taken down into the center of the cut. Sampling ahead of the work in this manner proved to be a wise move as it was discovered that the "R" value necessary for the top layer of the select material could not be obtained from this cut. The drill rig brought material up from two of the test holes which gave the appearance of being a rich oil mix, but which proved to be two veins of low grade coal when the cut was finally excavated. Streambed gravel from Warthan Creek, approximately 1,000 feet south of Station 60, was tested and found to be satisfactory and was used in place of 12,500 cubic yards of the lower grade material of sandstone and coal from the "big cut."

Project Cost $203,000

The bituminous surface treatment was done using SC-3 and SC-4 liquid asphalts with a Gardner mixer supplemented with blade mixing. The portion of the road using the sandstone select material from the sidehill cut at Station 15+00 was found to be extremely difficult to mix. The sandstone material was very absorbent—having a "K" factor by the centrifuge, Kerosene



UPPER—Channel change and new road at Lone Pine Inn. Bridge across Hot Springs Canyon Creek at easterly end of project. Ninety-foot hill cut approached by 2,500-foot radius curve. New 7,600-foot tangent replaces winding road on right. Sharp curve on old road three miles from easterly end of project eliminated by new alignment.



These are the "old timers" who for years have been working for Worthan Canyon project. LEFT TO RIGHT—F. J. McCallum, editor Coalinga Record; Frank Wells, J. G. Cheney, Highway Commissioner Warlow, Jacob Zwang, Robert Abel, Coalinga Hot Springs.

Equivalent Method of 1.5—and tests showed that the optimum oil content would be 9-12 percent. SC-3 liquid asphalt was added in four applications, mixing with the Gardner and power blades after each application. Approximately 8 percent of SC-3 was finally mixed into this material. The streambed gravel on the remaining section was readily mixed and laid with addition of 5.5 percent of SC-4 liquid asphalt.

After one week of traffic, a Class "C" medium seal was applied, using approximately 22 pounds of rock and 0.25 gallon of penetration type emulsion per square yard.

The total construction cost of this project was $203,000. The contractor was John F. Blakemore of El Monte, California. The author was resident engineer, and the bridge department representative on the Hot Springs Canyon Bridge was A. E. Hoerchner.

Great Loss

Continued from page 4 . . .

istration and the Department of Public Works in obtaining through Congress and the Reconstruction Finance Corporation the funds necessary for the building of the bridge. However, these funds were obtained, largely through Mr. Purcell's efforts in Washington, and the Stanford freshman who had worked as a messenger boy in the Chicago Grain Pit began the stupendous task of bridging San Francisco Bay.

The bridge was opened to traffic November 12, 1936.

Charles H. Purcell is an honorary member of the American Society of Civil Engineers, and a recognized national authority on public highways.

He is also a member of the National Executive Committee of Ten of the American Association of State Highway Officials and is a representative of the United States on the Permanent International Commission of the Permanent International Association of Road Congresses.

Mr. Purcell was appointed a member of a committee of 12 nationally known highway engineering experts by Secretary of Agriculture Henry Wallace in June, 1937, to promote maximum safety and highway utility; official title—Special Committee for the Consideration of Administrative and Design policies for Highways.

He served as President of the American Association of State Highway Officials in 1938.

In November, 1937, Mr. Purcell was appointed Executive Officer, California Commission for the 1939 Golden Gate International Exposition.

In 1944, the coveted George S. Bartlett Award was conferred upon Mr. Purcell by the American Association of State Highway Officials, the American Road Builders Association and the Highway Research Board of the National Research Council for "outstanding contribution to highway progress."

He holds honorary degrees of Doctor of Laws from the University of California; and Doctor of Engineering, University of Nebraska.

HIGHWAY COSTS

By RICHARD H. WILSON, Assistant State Highway Engineer; HENRY C. McCARTY, Office Engineer, and RICHARD R. NORTON, Assistant Office Engineer

The past 15 months have shown the most rapid increase in highway construction costs in California that has occurred since 1940.

This was revealed by the latest California Highway Construction Cost Index compiled by Richard H. Wilson, Assistant State Highway Engineer; Henry C. McCarty, Office Engineer, and Richard R. Norton, Assistant Office Engineer, of the Division of Highways.

The cost of state highway construction in California has increased 22.3 percent in the first half of this year and 48.9 percent during the past 15 months.

From the California index there is no indication that this upward trend will not continue in the future.

However, there are two other indexes that show a leveling off in the last several months. The Bureau of Labor Statistics Wholesale Price Index showed no increase from February to May, 1951, after rising 20.1 percent in the preceding 10 months. The Engineering News Record Construction Cost Index showed only a 1 percent increase from February to June, 1951, after a 10.7 percent rise in the preceding year.

From the trend indicated by these other indexes and a general knowledge that an oversupply of many consumers goods now exists, it may be reasonable to expect that a peak in the California Highway Construction Cost Index has been reached and there will at least be a leveling off in the near future.

Highway costs, as measured by the California Highway Construction Cost Index with the year 1940 taken as a base of 100, climbed during World War II and the postwar period to a peak of 216.8 in the first half of 1948. After 1948 there was a decline to 160 in the first quarter of 1950. From this point on there has been a very rapid rise. The second quarter of 1950 was 12.5 percent above the first quarter of 1950; the third quarter was 5.1 percent above the second quarter; the fourth quarter was 3 percent above the third quarter; the first quarter of 1951 was 10.6 percent above the fourth quarter of 1950, and the index reached 238.3 in the second quarter of 1951, which was 10.6 percent above the first quarter.

Following is a tabulation of the California Highway Construction Cost Index since the first postwar peak was reached in the first half of 1948:

Period	Index 1940=100	Change from previous period	Change from first half 1948	Change from first quarter 1950
1948 (first half)	216.8			
1948 (second half)	216.4	—0.2%	—0.2%	
1949 (first quarter)	200.4	—7.3	—7.6	
1949 (second quarter)	195.7	—2.3	—9.7	
1949 (third quarter)	187.9	—4.0	—13.3	
1949 (fourth quarter)	178.8	—4.8	—17.5	
1950 (first quarter)	160.0	—10.5	—26.2	
1950 (second quarter)	180.0	+12.5	—17.0	+12.5%
1950 (third quarter)	189.2	+5.1	—12.7	+18.3
1950 (fourth quarter)	194.8	+3.0	—10.1	+21.8
1951 (first quarter)	215.4	+10.6	—0.6	+34.6
1951 (second quarter)	238.3	+10.6	+9.9	+48.9

In Memoriam

WILLIAM T. HART

Appointed to the State Highway Commission by Governor Frank F. Merriam on July 7, 1936, William T. Hart of Carlsbad, the first Highway Commissioner from San Diego, died in an Oceanside Hospital on June 17th, at the age of 81 years. Mr. Hart had a distinguished record in public service.

A resident of Carlsbad for 30 years, Mr. Hart was resident agent for the South Coast Land Co., which owns property along the coast between Oceanside and Del Mar. He managed this company when it built the Del Mar Hotel.

He was appointed to the State Park Commission during the administration of Governor James Rolph, Jr., and aided in acquiring parks in San Diego County which now are a part of the State Park System.

Mr. Hart was a director of the Union Title Insurance & Trust Co. of San Diego, prior to his appointment to the Highway Commission by Governor Merriam. He was a district vice president of the California Real Estate Association and was an original director of the Oceanside Commercial & Savings Bank, which later was absorbed by the Bank of America. He was the first president of the San Diego County Development Federation.

A lifelong Republican, Mr. Hart had been active in affairs of the party. He was a Mason and was affiliated with the Scottish Rite Bodies, Shrine, Sciots and Grotto. He also was a member of the I. O. O. F.

Surviving are his widow, Mrs. Sarah M. Hart, and two sisters in Canada.

TRACY PUMPING PLANT

At the Tracy Pumping Plant near Tracy, California, six huge pumps, each driven by a 22,500-horsepower motor, lift water from the Delta 200 feet into the Delta-Mendota Canal, on the rim of the Central Valley Basin's western foothills.

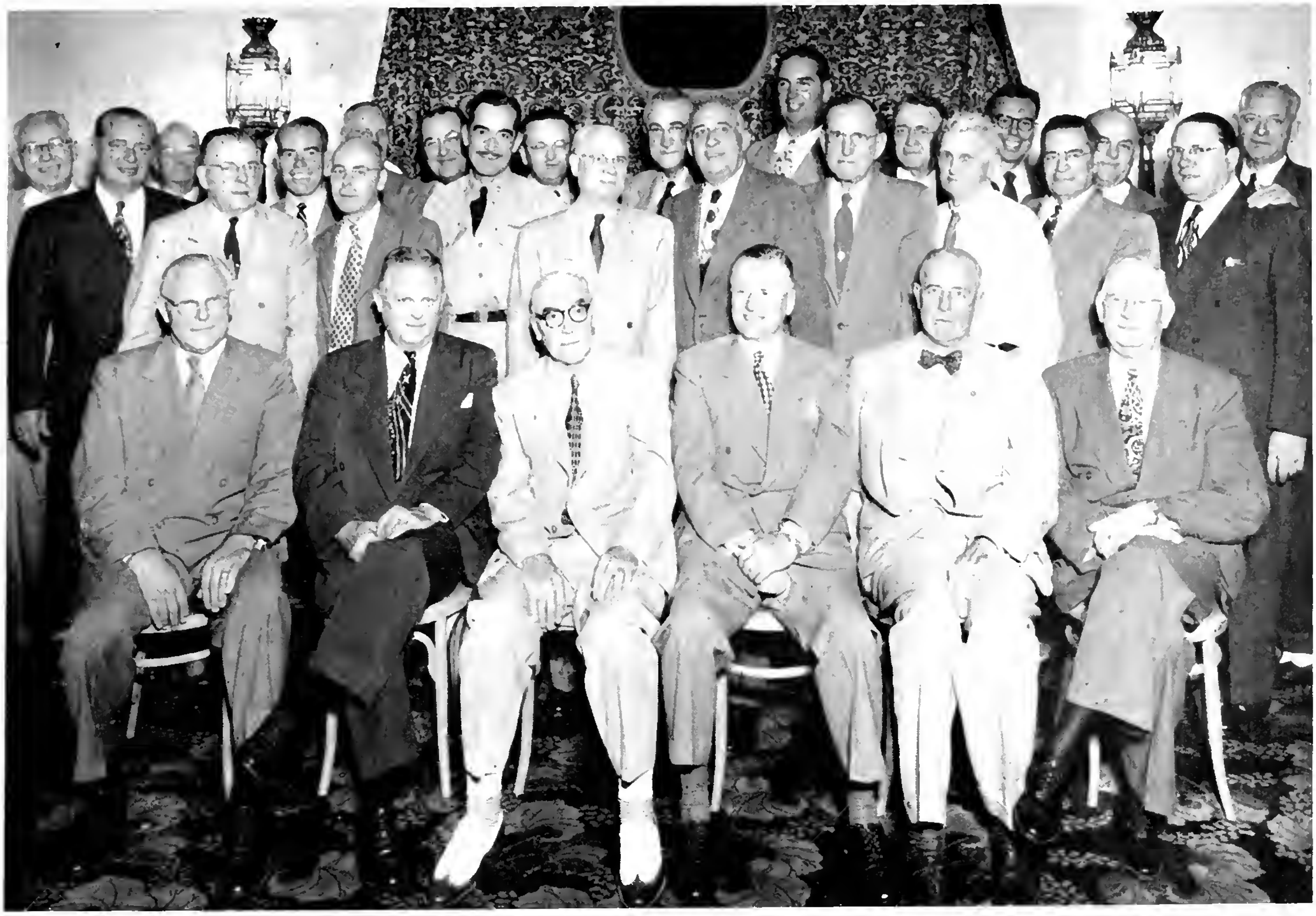
SHASTA LAKE

Shasta Lake, behind the Shasta Dam on the Sacramento River, when full will hold 1,460,000,000,000 gallons of Central Valley Project water, or enough to cover 450,000,000 acres of land to a depth of one foot.

C.V.P. OBJECTIVE

The prime objective of the Central Valley Reclamation Project is an equalization of the Central Valley Basin's water resources between the surplus water area in the north of California and the water deficient southern two-thirds of the valley.

Highway Commissioners and State Chamber Meet



ON JULY 19, 1951, the Executive Committee, State-wide Highway Committee, California State Chamber of Commerce, met with the California Highway Commission in Sacramento. The following were among those who attended the Annual Get-together Luncheon at the Sutter Club in Sacramento:

SEATED *(left to right)*: Highway Commissioners F. Walter Sandelin, Ukiah; Harrison R. Baker, Pasadena; and Chairman Charles H. Purcell, Sacramento; State-wide Highway Committee Chairman Neil Petree, Los Angeles; Highway Commissioners Chester H. Warlow, Fresno; and James A. Guthrie, San Bernardino. STANDING *(left to right)*: Assistant State Highway Engineer Paul O. Harding, Los Angeles; Rights-of-way Study Committee Chairman Dudley W. Frost, Oakland; California Highway Commission Secretary R. C. Kennedy, Sacramento; Senator Jesse Mayo, Angels Camp; Central Valley Highway Committee Chairman Irving Symons, Sonora; Chief Attorney of the Division of Contracts and Rights-of-way Robert E. Reed, Sacramento; Highway Deficiency Study Committee Chairman Frank H. Mogle, San Bernardino; North Coast Highway Committee Chairman Frank W. Luttrell, Santa Rosa; General Lacey Murrow, Commanding General, 434 Transport Carrier Wing, Camp Atterbury, Indiana; Central Coast Highway Committee Chairman Dr. E. J. Leach, Salinas; State Department of Public Works Deputy Director Frank B. Durkee, Sacramento; State Highway Engineer George T. McCoy, Sacramento; Central Coast Highway Committee Vice Chairman Claude T. Faw, Berkeley; San Joaquin Valley Highway Committee Vice Chairman Charles S. Ehrhorn, Visalia; Assistant State Highway Engineer J. W. Vickrey, Sacramento; Deputy State Highway Engineer R. M. Gillis, Sacramento; San Joaquin Valley Highway Committee Chairman W. S. Hillis, Madera; Sacramento Valley Highway Committee Vice Chairman John O. Bronson, Sacramento; Assistant State Highway Engineer R. H. Wilson, Sacramento; Chief Right-of-way Agent Frank C. Balfour, Sacramento; California State Chamber of Commerce General Manager James Mussatti, San Francisco; Southern California Highway Committee Vice Chairman Kenneth Kendrick, Los Angeles.

State Fair

Thousands Will Travel Over Splendid Highways to See It

CALIFORNIA'S splendid highways, which have contributed in great measure to the tremendous growth of California, will pave the way to the magnificent terminal where the treasures of the Golden State will be unveiled at California's Ninety-second State Fair in Sacramento, August 30th through September 9th.

Development of state highway routes to meet the needs of traffic is continuing at the accelerated rate which was made possible under provisions of the Collier-Burns Act of 1947. During the four years since the act became effective, 1,424 highway construction contracts with a value of $327,301,200 have been placed under way.

During this period improvement has been made to a total of 4,017 miles of highway, of which 3,192 miles are located on the State Highway System, the remainder being on county roads in the Federal Aid Secondary System, in state parks and state institution grounds.

Divided Highways and Freeways

Traffic congestion in recent years has necessitated accent on development of four-lane divided highways and freeways on the more heavily traveled state routes, particularly in urban areas. Such four or more lane construction on the State Highway System completed since July, 1947, now under construction, or budgeted for the current year, totals 691.4 miles of which 599.1 miles are freeways.

Included in the yearly programs for state highway development are many projects on routes leading directly toward Sacramento from the several sections of the State.

U. S. 40 Improvement

Construction now under way on U. S. 40 between San Francisco and Sacramento is rapidly bringing to culmination the four-laning of the 90 miles from the state capital to the bay. Construction projects under way on this portion of route will provide continual four-lane divided highway standards from the Carquinez Bridge to Sacramento with the exception of the Yolo Causeway, which is undivided. The work nearing completion in Solano County is being performed under two contracts and provides for construction to freeway standards of the six miles from the Cordelia Underpass to Ledgewood Creek near the county hospital and 1.7 miles through the southerly portion of Vacaville. The cost of these two improvements will be about $2,000,000.

West Sacramento Freeway

In Yolo County, between the easterly end of the causeway and the Tower Bridge across the Sacramento River at the westerly entrance to the capital city, five contracts with a total value of more than $900,000 are under way for the construction of eight grade separation structures necessary to freeway development on this portion of the route. Grading of the freeway will follow upon completion of the structures, a sum of $520,000 having been included by the Highway Commission in the state highway budget for the current fiscal year. Pavement will be placed as soon as the graded roadbed is complete.

New Elvas Bridge

Work is progressing rapidly in placing the substructure of the new bridge at the Elvas Crossing of the American River on the proposed new approach of State Route 98 into Sacramento at 30th Street. The cost of the piers and abutments of this structure will total about $730,000. Included in the current budget is an amount of $750,000 for necessary grade separations on the approaches of the new bridge. Construction of the superstructure of the bridge and grading and paving of the proposed highway from C Street in Sacramento to a connection with U. S. 40-99E near Swanston Road will follow as funds are budgeted by the Highway Commission.

The sketch on the opposite page was drawn by Van der Goes, Bridge Department, Division of Highways

Widening H Street Bridge

To provide more adequate facilities for traffic entering Sacramento from the north on old Route 98, the State is widening the H Street bridge over the American River to four lanes at a cost of $146,000 and the county and city are widening the underpass through the levee under the Southern Pacific Railroad and constructing four-lane divided pavement from the subway to Fulton Avenue.

Improvement of the so-called "River Road" between Woodland and Sacramento is being performed under a contract for widening and surfacing portions totaling 5.1 miles between E Street in Woodland and the Yolo By-pass. The cost of this work will be nearly $200,000. Another project on this route is included in the budget for the current year in an amount of $150,000 for grading and surfacing from one-half mile north of Kiesel to two miles south of Kiesel.

On U. S. 40 easterly of Sacramento, the six miles of four-lane divided highway between Auburn and Applegate has been opened to traffic during the past year. Plans are proceeding for carrying development of this route to freeway standards from the easterly end of the North Sacramento freeway to east of Roseville. Under a contract started this spring portions of this route on the grade between Donner Lake and the summit are being widened to relieve traffic congestion over the pass.

On U. S. 50 a contract is under way for straightening and widening two miles between the railroad crossing east of Placerville and Five-mile Terrace. This improvement will cost about $326,500.

Alameda County Projects

Improvement of highways more distant, but nevertheless leading to Sac-

. . . Continued on page 54


WELCOME TO THE CALIFORNIA STATE FAIR
SACRAMENTO
LOS ANGELES
EUREKA
BAKERSFIELD
SAN FRANCISCO
FRESNO
REDDING
NEEDLES
BISHOP
SUSANVILLE
AUG. 30 TO SEPT. 9, 1951

South of Border

Continued from page 5 . . .

Inginerio Manuel Lopez-Vela, Chief of Construction, would arrive in Hermosillo on Sunday afternoon, July 15th.

Field Inspection Made

Monday morning, following further discussion with Governor Soto, a field inspection was made over the road to Kino Bay. The roadbed had been graded and shaped up but it was without surfacing or drainage structures. The country is generally arid and strongly resembles the desert regions of Southern California and Arizona. The land is relatively level, broken occasionally by small elevations or outcroppings of barren rock. The proposed highway traverses an area of gravelly soil which would produce an excellent road building material but this deposit terminates a few miles westerly from Hermosillo, after which the soil becomes heavier with considerable clay, finally changing to large areas of fine alluvial silt which makes up the excellent farm land of the lower Sonora River Basin.

This westerly area posed the chief problem leading the Mexican engineers to ask advice as the absence of readily available gravel or sources of crushed stone led them to consider the possibility of stabilizing the existing soil by some means.

Hveem's Recommendations

After an inspection of the materials and the existing roadbed, recommendations were made to utilize the local gravel within the limits of economical haul for the easterly portion of the project, a distance of some six or seven miles. Gravel was not available for the second section and the soils appeared to contain too much clay for economical or practical stabilization methods. However, small outcroppings of rock immediately adjacent to the highway appeared to be suitable sources for the development of crushed stone. This material could be utilized for the intermediate section reaching to the areas of fine silty soils. It was recommended that consideration be given to the use of Portland cement to form a stabilized base to be covered by a bituminous surface hauled from the quarry sites mentioned above. Final recommendations, of course, were contingent upon the results of tests to be performed in the California laboratory upon the roadbed soils.

Sonora Enjoying Boom

After final discussions and tentative conclusions were reached, the engineers proposed a trip over the highway south of Hermosillo through the coastal city of Guaymas and farther south to Obregon and Navojoa. The highway from Nogales, Arizona, through Hermosillo to Guaymas is built on generally high standards of alignment and roadbed width and surfaced with dense graded roadmix bituminous mixture. The road from Hermosillo to Guaymas is in excellent condition. The surfacing is not yet completed on the portions further south to Navojoa. The new highway is now under construction, the gravel base now being placed will be surfaced by roadmix method. The highway south of Guaymas in the vicinity of Obregon and Navojoa traverses broad areas of farmlands, some under cultivation with many square miles now being cleared and prepared for farming.

Sonora is enjoying an agricultural boom; in addition to large areas of fertile land several factors have combined to encourage this development, chief of which has been the energetic activities of the able men who have held the position of governor in recent years.

Progressive Building Program

The former Governor Rodriguez of Sonora spent much time and money in the construction of dams to conserve the available water and also built many new and modern school buildings. At present, Governor Soto has continued the work on hospitals and schools and is placing special emphasis upon highways. The efforts of the state have been further aided by the interest and support of President Aleman. The Sonorans now feel particularly optimistic over their future and from a previously rather underdeveloped condition, Sonora is now rapidly forging to the front among the states of Mexico. The highways are being constructed to high standards of alignment and grade with elevated grade lines for the most part well above danger of flooding.

The Federal Government maintains a materials laboratory in Navojoa and tests are conducted regularly on aggregates, soils and other materials of construction. Summer temperatures are high and field survey crews go to work as early as 5 a.m. as transit work becomes very difficult in the heat of the day.

Rich Area Needs Water

The return trip from Novojoa to Hermosillo was made by plane. The aerial view discloses a vast area of rich land which needs only water to produce heavily. The return to the air-conditioned hotel in Hermosillo was by no means unpleasant on the nineteenth of July, and departure for Sacramento was made at 4.40 a.m. the next morning.

The brief trip to Sonora was interesting and instructive. The Mexican engineers are coping with the problem of constructing highways and encounter many of the difficulties familiar to engineers in California, chief and most chronic of which is the lack of funds to build the roads that are needed. In spite of the fact that life proceeds at a somewhat more leisurely pace and at a more sedate tempo than is the case in California, the amount of work accomplished is impressive. Engineers and public officials in Mexico realize that there is much to be done. One American mining engineer who had lived in Mexico for over 40 years summed it up: "There is much to do but we do not try to do it all in one day."

Anyone having first-hand acquaintance with the pressures involved in the administration of a modern highway program could not help but enjoy the absence of nervous tension and the generally serene attitude with which problems are faced in Mexico.

As the plane circled above the airport before heading northwesterly to California, one looking down on this old Mexican city in the moonlight, could understand something of the feeling that led the founders to name the town Hermosillo, which may be literally translated as the place that is "a little beautiful."

WASHO

Highway Engineers From Western States, Texas, Alaska and Hawaii Hold Meeting

With more than 300 delegates and guests in attendance, the Western Association of State Highway Officials held its thirtieth annual convention in San Francisco June 25th-28th.

The meeting was considered one of the most successful ever held by the association.

Governor Earl Warren went to San Francisco to extend a welcome on behalf of the State of California. Highway officials of the 11 western states—Washington, Oregon, California, Arizona, New Mexico, Nevada, Utah, Wyoming, Montana, Idaho and Colorado—and of Texas and the Territories of Alaska and Hawaii attended.

MacDonald and Hale Attend

Thomas H. MacDonald, U. S. Commissioner of Public Roads, Washington, D. C., headed a delegation of officials of the Bureau of Public Roads from the various states. He was accompanied by Hal H. Hale, Secretary of the American Association of State Highway Officials.

Highlighting most of the principal addresses was the theme of highways for national defense with emphasis also being placed on the need for increased efforts to diminish the tragic toll of deaths and injuries caused by traffic accidents.

General sessions in the Fairmont Hotel were called to order by President W. L. Anderson, Utah Highway Department, at 10 a.m. on Monday, June 25th. Following an invocation by Rev. James Lyons, S.J., University of San Francisco, a redwood burl gavel was presented to President Anderson by Supervisor T. Fred Bagshaw, Marin County head of the Supervisors Unit of the Redwood Empire Association.

State Highway Engineer George T. McCoy, pointing out the importance of the convention in these critical times, extended a welcome on behalf of the California Division of Highways.

San Francisco's official welcome was extended by City Engineer Ralph Wadsworth, representing Mayor Elmer E. Robinson.

STATE HIGHWAY ENGINEER GEO. T. McCOY

Following a roll call of states by Secretary-Treasurer J. A. Elliott of Texas, President Anderson delivered the opening address.

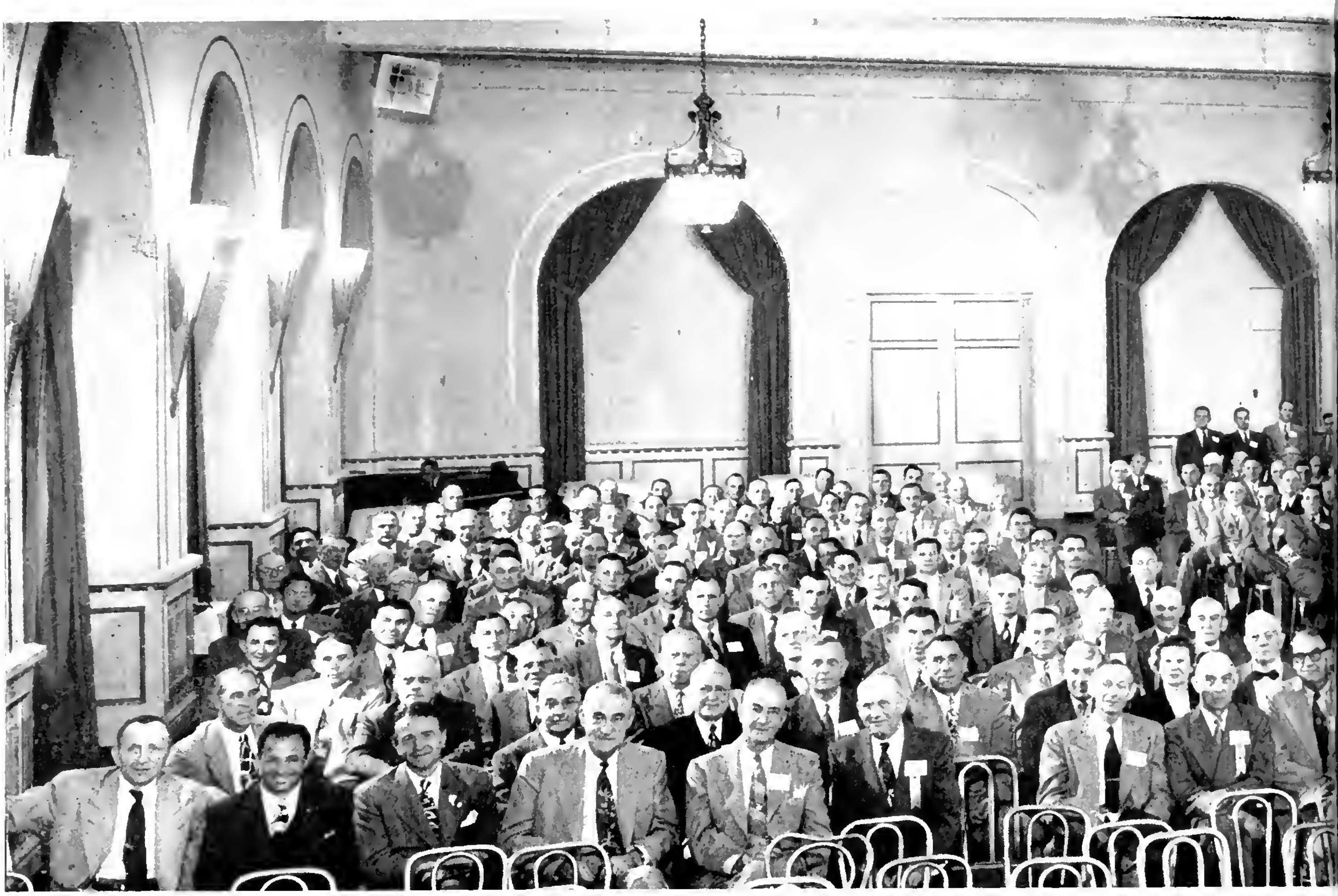
President Anderson Speaks

President Anderson stressed the urgent need for acceleration of construction of our highways to a modern standard, so that they will be able to carry the enormously increased loads and volumes of traffic which will be demanded of them should all-out war occur. He said, in part:

"It is eight years ago since WASHO last met in San Francisco. Fatefully, we were then, as now, entering a critical period with restrictions on highway construction beginning a like period of priorities and allocations of critical materials. At that time, we were entering the war where an all-out effort in conserving materials and manpower was necessary to build up this Nation into the greatest arsenal in the history of the world. To do this, the theory was advanced that roads were expendable, yet they played a part in that war that prevented a complete collapse of the transportation system. Other forms of transportation would have bogged down completely had it not been for the roads which carried the enormous quantities of materials and personnel. A Senate committee, in examining the Nation's war effort, found that "war production is dependent upon an economy geared to rubber." William M. Jeffers, Rubber Director of the War Production Board, declared "The greatest lesson of war is that domestic economy in this Country depends upon transportation—not only the transportation that is afforded by the railroads, airplanes, busses, and trucks, but also the individual transportation which every family has in its automobile."

All-out Preparedness

"As of today, we are not yet in an all-out war, and our effort is one mainly of preparedness. Considering that the highways have not yet recovered in necessary reconstruction of surfaces, bridges, etc., that took a terrific beating and neglect during the last war, I certainly believe that a most vital part of our preparedness program should be to accelerate the construction of our highways to a modern standard, so that they will be able to carry the enormously increased loads and volumes of traffic which will be demanded of them should an all-out war occur. Nothing could be more disastrous that a bog-down in highway transportation. I thought that this idea had been sold, yet of recent date those in authority in our national government have put out restrictions to hamper the highway program and have also requested that the legal load limits be waived or increased, as though by an act of law or regulation a road surface or bridge can be made to carry heavier loads. Increasing loads would only break down our present highway structure to what could easily be an impassable road. Before the railroads increase speed or



Delegates to Western Association of State Highway Officials assembled for first day's sessio

loads, their tracks are modernized with better alignment, grades, ballast, and heavier rails. The highways have always had a reversal of this procedure, rebuilding the highways after the increased load and volumes have been imposed, which has resulted in terriffic costs in maintenance dollars, vehicle operation costs, and accidents.

Must Be No Slow-down

"There is only one solution, and that is to rebuild our inadequate roads and bridges at an accelerated rate rather than a slow-down. I believe emphasis should be given to our main highways, especially the interstate system, though not restricted to this system. In the West, unlike the East, our large areas have been developed in the motor age and are, therefore, not served by railroads. These areas contribute large amounts of food, minerals, and other raw materials to our national economy, and their entire existence depends on motor transport. The roads to such areas cannot, therefore, be neglected, though they are secondary in character. For example, eight counties of the 29 counties in Utah are not served by any railroad, and in many of the other counties only a small percentage of the communities have railroad transportation.

"We realize there may be, for a period, not enough steel and other critical materials for our civilian and military consumption. However, highways should be given one of the highest priorities. If allocation is still necessary, it should be given to an agency which knows the highway problem and can make intelligent evaluation as to the necessity of the improvement. The Bureau of Public Roads should adequately qualify for this position. The allocation system should be set up so that prompt action can be obtained, as delays to our program in filling out forms and passing these through numerous hands will seriously retard our national preparedness program. Our highways are needed now.

Problem of Bottlenecks

"With more highly developed long-range aircraft and more devastating explosives, consideration, as part of the civilian defense and preparedness program, should be given to the elimination of serious bottlenecks which might be blocked by bombing, sabotage, etc. Long stretches of alternate road cannot be built, but often short by-passes can be improved where structures and other physical obstacles will cause a most serious delay in repair of the highways or detouring the traffic. I believe an examination of this problem in each state should be given serious consideration.

"With the rapid increase in population which is occurring in most western states, sacrifice of any of our design standards can lead to early obsolescence with practically a total loss of our capital improvement. I believe if we are

thirtieth annual convention in the Terrace Room of the Fairmont Hotel in San Francisco

ever going to get a modern highway system, every cent that can be spared from maintenance and temporary emergency repairs should be spent on reconstruction with present-day modern standards, and to design for the projected increase in traffic within a reasonable period. It has been observed that widening and providing better surfaces generally increases the speed of traffic. Leaving inadequate alignment with curves which may appear to have a reasonable radius, and a grade line which does not meet the standards for sight distance for the traveled speed, or the sacrifice of most other good design features, will therefore contribute to an increase in accidents, and result in early obsolence of the improvement. Continuous rebuilding of our roads with loss of capital investment justly destroys the confidence of the public.

"It is our job to convince the public, Congress, and the legislatures that half-way construction is false economy and more money must be made available so that we can proceed with a program of high type modernization of our highways with a reasonable rate of progress. The truck owners and passenger car owners, I am sure, are willing to pay for good roads. This has been demonstrated on toll roads where the vehicle drivers are willing to pay approximately an additional cent per mile for passenger cars with increased sum for trucks in order to ride over a modern highway, rather than a parallel, inferior road of inadequate design. Economic analysis of vehicle operation over a proposed improvement, as compared with an existing facility will often show savings which will amortize the improvement in a few years. Such factors are shorter distances, grade reductions, savings due to elimination of traffic jams and stops, reductions in vehicle maintenance, and especially in the reduction of accidents. Indirect savings also result to the public, due to reduced maintenance costs of such facility and in the over-all economy through reduction of transportation costs and better highway transportation service.

"It is the duty of the highway department to furnish all necessary data as to cost and needs; however, it should not be left entirely for the highway department to sell the program while the beneficiaries argue as to the distribution of the costs.

"The reason that secondary roads are given increasing consideration by the legislatures and Congress is because the farm lobbies and other local organizations and the individuals who live on such roads, which is a large proportion of the population in these areas, are constantly bringing this problem before the county commissioners, the legislatures, and the Congress; while few, except the highway administrators, lobby for funds for the main highways. In fact, the construction of primary road improvements is often criticized

RESOLUTION NO. 1

WHEREAS, The duly constituted authorities of the Government of the United States have found it desirable and necessary to place restrictions on the utilization of critical materials in order to properly carry out the necessary functions of the national defense; and

WHEREAS, The National Production Authority of the Department of Commerce has issued its Order M-4 relative to all types of construction including highways and roads; and

WHEREAS, The National Production Authority has most properly delegated the key functions under Order M-4 relative to roads and streets, through the Secretary of Commerce, to the Bureau of Public Roads; and

WHEREAS, Said delegation of authority on roads and streets has provided to the state highway departments a most logical procedure under said Order M-4; now, therefore, be it

Resolved, That the Western Association of State Highway Officials, assembled at San Francisco, California, on June 28, 1951, express its commendation and thanks to the National Production Authority for its wisdom in selecting this most efficient method of handling this difficult problem.

The president of the Western Association of State Highway Officials is directed to transmit copies of this resolution to: Mr. Manly Fleischmann, Administrator, National Production Authority; Mr. Charles Sawyer, Secretary of Commerce; and Mr. Del Rentzel, Under-secretary of Commerce.

WASHO President Anderson was accompanied to the convention by Mrs. Anderson and son, Dan

by the local people, due to new rights of way and small town by-passes being required for modernization, so that the small portion of people who think that they will be inconvenienced by such changes often cause considerable delay or modifications which sacrifice good design. The highway department seldom receives the support it should by the highway user organizations who would be the beneficiaries, even though such organizations are in favor of the improvement.

Against Federal Fuel Tax

"Increase in federal fuel tax is again being considered by Congress. I vigorously protested this action to the members of the congressional committees on taxation and highways. The main argument brought up in the Utah State Senate for the reduction of the proposed motor fuel tax increase from 2 cents to 1 cent was that the proposed increase would result in a total $3\frac{1}{2}$-cent increase, including the proposed increase in the federal tax.

"It is my opinion that we should continue to vigorously oppose federal fuel tax increases and leave this source of funds for state revenue which is so badly needed in our highway preparedness program. I also recommend that the association request Congress to return to the states a larger percentage of the motor vehicle and motor fuel federal taxes now collected by increasing federal aid highway appropriations. The Federal Government is not consistent wherein they penalize a state for diversion of road user taxes, yet they divert a large percentage of such federal taxes for other purposes.

"Though the association has in the past emphasized to Congress the need for adequate forest highway appropriations, these appropriations are still behind the authorizations as made in the highway acts. This revenue is very much needed at this time in the development of forest highways to obtain the necessary timber and other raw material to meet the increasing demands of these materials for defense purposes. The forest appropriation affects mainly the western states, and it is, therefore, our duty to call the attention of Congress to the urgency of adequate appropriations for this purpose.

"Before closing, I would like to mention one other thing which should cause some serious thinking. This year will probably see the one-millionth man who has died in the defense of his country in all wars since the first gun was fired for independence in 1776. Also this year, we will have the

RESOLUTION NO. 2

WHEREAS, It will be necessary that the National Congress re-enact the Federal Aid Highway Act in 1952 if continuity is to be provided for the programs of development of the highway systems of this Country; now, therefore, be it

Resolved, by the Western Association of State Highway Officials, assembled at San Francisco, California, on June 28, 1951, That the Executive Committee of the American Association of State Highway Officials be requested to take all necessary steps, in the Fall of 1951, to prepare data and a program to support a proposed Federal Aid Highway Act of 1952, in order that no time may be lost in the enactment of such necessary legislation by the National Congress as early as possible in the 1952 session.

one-millionth man killed by motor vehicle, in a comparatively much shorter period. Our expenditures to save lives in battle is tremendous, but are we not calloused to the highway deaths and are we as a Nation, state, community, and individuals doing what we can to reduce this slaughter?

"I have emphasized in my paper the necessity for taking into consideration every reasonable factor which will reduce accidents, and I recommend that as an association and as highway administrators we consider highway accident reduction as our number one problem, so that we can travel over our highways with a reasonable degree of safety."

Baldock of Oregon Speaks

State Highway Engineer R. H. Baldock, of Oregon, held the attention of the convention with a constructive address on "Essentiality of Highway Construction to the National Defense Effort" which is printed elsewhere in this issue.

During luncheon in the Tonga Room of the Fairmont Hotel on Monday, the delegates heard Howard G. Vesper, President, California Research Corporation, who discussed the oil potentialities of the West and the production of oil from shale.

The principal speaker at the afternoon session was U. S. Commissioner of Roads MacDonald, whose subject was "Maintaining a Sound Highway Plan." Other speakers were Secretary Hale, of the American Association of State Highway Officials, George Keating, Production Engineer, Office of Defense Mobilization; Assistant State Highway Engineer R. H. Wilson, of the California Division of Highways, and A. N. Carter, Co-Secretary, the Associated General Contractors of America, whose subject was, "Contracting in a Period of National Emergencies."

Vice President Nash Presides

Vice President A. M. Nash, District Highway Engineer of the Division of Highways, Eureka, presided at Tuesday morning's general sessions, during which the convention heard addresses by Fred Burggraf, Associate Director Highway Research Board; Wade Sherrard, General Manager, Motor Truck Association of California, who promised the support of his organization in all matters pertaining to the protection of highways; and State Highway Engineer W. A. Bugge, of Washington State, who discussed relations between state highway engineers and contractors, in an interesting address on "Penalties for Overrun in Contract Time."

Warren Urges Increased Safety

Governor Warren was given an ovation when he arrived to address the convention at 11 a.m. In his talk "The Importance of Highways to the West," he took advantage of the occasion to make an urgent plea for cooperation between all federal and state and local agencies in reducing traffic accidents on highways.

Tuesday afternoon Deputy State Highway Engineer R. M. Gillis, California Division of Highways, presided at an operations session which heard Earl Withycombe, Assistant State Highway Engineer, Sacramento, on the subject of "Cement Treated Base Construction in California"; Ralph Moyer, Research Engineer, Institute of Transportation and Traffic Engineering, University of California, on "Skid Resistance Measurements"; Walt Winters, Chief Engineer, The Asphalt Institute, on "Simplification of Grades of Asphalt," and Bailey Tremper, Materials Engineer, State of Washington, on "Paints and Protective Coatings."

State Highway Engineer Mark U. Watrous, of Colorado, presided at the Design Session Tuesday afternoon. Speakers were Eugene Maier, Chairman, Highway Research Board, "Channelization and Intersections"; William E. Willey, Engineer of Economics and Statistics, Arizona, "Truck Speeds on Grades"; V. A. Endersby, Chairman, Trivial Institute Research Cooperators; and Harmer Davis, Director, Institute of Transportation and Traffic Engineering, University of California, "Analysis of Data on Accident Statistics."

Annual Dinner

The annual WASHO dinner was held in the Gold Room of the Fairmont Tuesday night.

. . . Continued on page 54

Governor Warren, left, U. S. Commissioner of Roads MacDonald and Director of Public Works C. H. Purcell absorbed in discussion of highway problems

Plea For Safety

Governor Warren Urges United Action to Reduce Highway Accidents

In welcoming the delegates to the Western Association of Highway Officials to California, Governor Warren made an urgent plea for united action designed to reduce accidents on highways.

A Plea for Safety

"I want to have all the agencies in our State which have anything to do with the traffic problem to work with those in every other state in the West, and I do hope that we can do something substantial about it," the Governor said.

"I think that we can do something about it in the planning of our highways. We know that we have 73 percent less fatal accidents on our divided highways, limited access highways, than we have on our regular highways, though they are good highways. So, I believe that the more freeways we can have, the more limited access highways that we can add to them to reduce hazards, and the other complications in traffic, the better off we will be.

"So, gentlemen, I believe that because you are interested in these same things in which I am interested, and in which our Highway Department is interested, we are more than fortunate to have you here with us in our midst.

"We know that we can learn from what you are doing in your states. We believe that something good is bound to come from counseling with one another.

"I believe that we can say with just pride that we are as progressive out here in the West as any other part of the Country. I believe we can say we are not afraid to try, if we believe something will accomplish good, and I believe we are about as neighborly a people as is to be found on earth, and with those qualities, and with natural western ingenuity and initiative and courage I believe that we can have programs that will develop the finest highway system in the world, and what is even more important, make them the safest for our people to ride on."

Governor Warren addresses convention

The Governor's address, in part, follows:

"I want to bring to you at this time a very cordial, even though it's a belated welcome. I regret that I could not have been with you yesterday and have had the opportunity of sitting through all of your discussions, because I know there is no one in my State who needs the benefits of your views or the inspiration of your presence more than I do.

"We in California are highway conscious until it hurts, because we recognize the seriousness of our deficiencies, and, as we look forward into the future, we realize that our problems are very, very great indeed. We are working on our problems every day, but we do have a greater sense of security that we have in our midst those from our neighboring states who are also highway-minded, and who are trying to do something about it. We realize that what we do here in California for highways, and what we don't do, affects your problems in the other western states, just as much as what you do and don't do, affects us.

United West

"We see in this great west and southwest country of ours, a region in which each state has much in common with its neighbors, and in the aggregate, constitutes an empire, an empire that stands in great strength to our Nation, and happiness and prosperity to those who live here, if we just plan properly for the future.

"And I have always believed that anything that helped any one part of this great western country, helps the entire West, and by the same reasoning, anything that hurts any part of the West, hurts the entire West.

"And so, we want to know what you are doing, and how you are doing it; we want to exchange ideas with you. We want to grow up with you, because every one of these western states and Texas as here represented, are still growing up. We are stil 'teenagers.'

Common Understanding

"We still have the better part of our lives before us, and the best way to do all of this is to have common understanding, and to do as much planning together as it is possible to do, particularly in the field of highways.

"I want to say to you, without any attempt at flattery, that no group of people in this great West is doing more to open, to use our natural resources, doing more to attract populations, or to expand markets, or to undergird our economy than your highway planners and builders.

"Our highways in California have had a very logical and a very natural development. They date back about 175 years. As a matter of fact, San Francisco is at present celebrating the 175th anniversary of her founding, and the foundation for our highways was laid a few years before that.

Padres Blaze First Highway

"First came the intrepid De Anza, and Portola to blaze the first trail in

California for His Majesty, the King of Spain.

"Then came the kindly padres, intent on establishing Christianity in western civilization in this great western world, and as a part of their travels through Southern and Central California, up through Sonoma, about 25 miles north of here, they established the El Camino Real.

"This was all done by the beginning of the nineteenth century.

"Then came the trappers and the traders, mountain men, such as Kit Carson, restless and adventurous, and they too developed trails across our mountains and our valleys.

Early Trails

"Then came the Argonauts across the Rockies, and across the plains, and across our own mountains, in their prairie schooners, in search of gold. They developed trails.

"Then came the pioneers, from the Louis and Clark Expedition, down through Oregon and through Northern California.

"Then, of course, after that, came the Iron Horse.

"And all of these moves established immigrant trails, which with few deviations, now constitute the major state highways in California.

"Then our motor vehicles came along, and they became the beneficiaries of all this travail until today we have one of the finer highway systems of the world.

"One of the greatest things about our highway system is that they bring us into closer contact and intimate friendship with you, our neighbors.

Spectacular Development

"People are still following the admonition of Horace Greeley to 'Go west, young man, go west.'

"There is no more spectacular change in the population pattern of this Country at any time, than has occurred in these western states and Texas during these past 10 years.

"In 1940, there were 20,000,000 people in these states. Today there are 27,000,000 people, and we have the same proportions so far as motor vehicle registration is concerned.

"In those states in 1940, we had 7,000,000 registered automobiles. In 1950, we had 12,000,000. The growth is fabulous, but as you all know, perhaps even better than I do, it creates problems, and one of those problems falls upon you as highway planners and builders and administrators.

Value of Highways

"Judging by present day trends, the future does not offer any haven of rest for any of our highway officials because, for instance, in California, our population has increased so rapidly that we are bewildered from day to day by the kaleidescope of the changing pattern of life.

"Life has been very good to us out here in the West, and I think principally because, or at least for one reason, because we have had people who have been devoting their lives to the development of good highway systems.

"No longer does rural life mean narrow isolation and drudgery for people, no longer does it mean congestion in our metropolitan centers. We have complete movement here, perhaps freer than in any other part of the world, and because of that, we all have a better life, and are building a better place in which to live for our children and for their children.

Postwar Construction

"But we must keep it up, day in, day out. In California, we have tried to do our part; we have initiated a program that has resulted in great development in our highway system.

"We started during the war, World War II, to accomplish this result, because during the depression years, and the very early war defense period, we had no opportunity to construct new highways, but we did do our planning during all the war years. We had our plans on the shelf.

"When VJ Day came along, it took us only a matter of weeks to get our construction started, but we were not financed adequately and it became necessary for us to adopt a more comprehensive plan based upon the recognition of the necessity for a system of highways with emphasis on limited access to them.

Highway Legislation

"So, in 1947, through the cooperation of all of the people in California who were interested in highways, we had a special session of the Legislature. The Legislature remained in session from January until June, until it knocked down all of the opposition to a good highway system and program, and emerged with what we know in California as the Collier-Burns Bill, which does increase the revenue of the State for highway purposes, and makes it possible for us to attack in a very substantial way the deficiencies which have accumulated through the depression years and the war years, and which were greatly accentuated by the tremendous growth during that same period.

Huge Program

"It might interest you to know, that since July 1, 1947, we have actually constructed $380,000,000 in highways under this single program. At the present time, we are advertising for $15,000,000 in bids and we have budgeted another $130,000,000 for the fiscal year beginning July 1, 1951, or, a total of $526,000,000 for actual construction purposes since July 1, 1947.

"With this money, we have built 3,722 miles of highways, including 584 miles of modern divided highways, and at the present time bids have been submitted for 136 miles more of divided highways.

"Now, this is progress, but it is not enough.

"We are falling behind, day by day, and we must find a way in California to accelerate our construction program because the registration of automobiles not only keeps pace, but it goes beyond anything we can do in the construction of highways.

"You know, our population has grown along with these other things. In 1940, we had 6,900,000 people in California.

"In the 1950 census, we had 10,560,000, and it is estimated that in 1960 we will possibly have 14,000,000 people.

"In automobiles we had approximately 3,000,000 in 1940, we had 5,000,000 in 1950, and it is estimated that we will have 6,500,000 in 1960. So, we just have to be highway-minded, we have to keep our minds on it, day in and out, and we have to do this not only for our own pleasures, not only for our own aggrandizement, but we must do it if we are going to play the part this great western country should play in the defense of our Country.

National Defense Factor

"I firmly believe that our system of highways will have a very marked influence upon the national defense program, whatever it may be.

"During these days, we have a good many responsibilities.

"I think that first, we have a responsibility to carry on our programs of highway development and maintenance, and to make them just as effective as possible in the national defense program.

"I believe we must continue to modernize and maintain our state highway systems, not only for the defense program, but for the happiness and the security of our own people, and for the purpose of attracting our neighbors from the Middle West and Eastern states to this great western empire of ours.

"I believe we must protect our highways against abuse of every kind. I believe that we must protect them against the abuse of overloading. I believe that Mr. Sherrard is correct when he says that the motor vehicle industry of this part of the Country is trying to work with us. I am sure, between them and you who are officials of the highway systems and our Legislature with its understanding, that we can protect our highways against overloading and other abuses that are designed to destroy them and make them not usable for all the purposes that they should be used.

Increased Safety Needed

"And then, I want to say something to you about safety. I believe that is one of our greatest responsibilities. It seems to me that there should be some way we can figure out a way to increase the safety factor. I don't know what the answer is. I have been a law enforcement officer for a good many years of my career. I've talked with most of the important law enforcement officials in this State. It seems to me that the matter is truly very complex.

"But, I do believe that those who are interested in good highways and the safety of our people have the ability to work out some kind of program that will keep us from destroying life as we have been doing at the present time.

HAL H. HALE, Secretary of AASHO

Appalling Toll

"You know, last year in the United States there were 35,000 people killed and 1,200,000 people injured in highway accidents. Why, that makes the Korean figures just look small and inconsequential. But still, nobody seems to get terribly excited about it. We do, if it happens to reach into our own homes or into the circle of our friends, but somehow or other there has never been a public awareness of the great danger on our highways, and until there is, I am satisfied that we are going to have an uptrend in accidents, and, in all probability, fatal accidents, because we are living in a world of speed. The farther we go along in that world of speed, the faster people want to travel on the highways, and many times, speed is accompanied by recklessness which raises the probability of accidents geometrically.

"So, I wish that we could bring about some kind of an understanding between law enforcement officials, judges, highway officials, highway users, and other interested groups that could result in a real, concerted and concentrated effort to knock down this terrible accident record that we have throughout our Country."

RESOLUTION NO. 3

WHEREAS, The Western Association of State Highway Officials recognizes the necessity and immediate need of construction of a test road in order to determine the effect of various axle loadings on nonrigid type of pavement; and

WHEREAS, The majority of the state membership of the Western Association of State Highway Officials have expressed their desire to participate in the construction and operation of a test road in cooperation with the National Academy of Sciences; and

WHEREAS, The National Academy of Sciences, through the Highway Research Board, has signified its willingness to supervise and administer the construction and operation of said road; and

WHEREAS, The Highway Research Board will obtain the cooperation of the Bureau of Public Roads and other interested agencies in financial participation; and

WHEREAS, Such financial participation will be approximately $95,000; and

WHEREAS, The estimated cost of said test road is $180,000, exclusive of the above mentioned participation; and

WHEREAS, The participation of the respective member states will be on an equal basis, except that the State of Nevada, by legislative restrictions, is limited to $15,000; and

WHEREAS, The location of said test road should be in an area where the climatic and soil conditions are representative of the greater portion of the western region, and to be as centrally located with respect to the participating states as possible; and

WHEREAS, Such location will be in an area consisting of Southeast Idaho, Southwest Wyoming or Northwest Utah; and

WHEREAS, The Standards Committee of the Western Association of State Highway Officials is so constituted to determine the specific location and prepare the specifications; and

WHEREAS, The Council of State Government recognizes the need for a test road in the western region as a basis of determination of the equitability of the highway users' costs; now, therefore, be it

Resolved, 1. That such a test road be undertaken and agreements entered into with the National Academy of Sciences to administer the test road.

2. That each participating state shall share equally in the cost of said road with the exception of the State of Nevada.

3. That the Standards Committee of the Western Association of State Highway Officials determine the specific location and specifications within 30 days.

4. That an advisory committee be established, consisting of one member from each participating state, to be appointed by the chief administrative officer, and one member representing the Council of State Governments.

5. That the present Subcommittee on Test Road Planning, as appointed by President Anderson, be continued and augmented by one member from the state wherein the test is located, until such time as the advisory board has been established and is operative.

6. That, if a specific location is not determined in 30 days, the states be again polled for an alternate location that can be expedited to completion.

California Again Wins Award of National Safety Council

State Highway Engineer McCoy holds National Safety Council annual award which was presented to Governor Warren, left, by F. M. Carter, extreme right. In center U. S. Commissioner of Public Roads MacDonald and Public Works Director Purcell.

FOR THE third time during his tenure of office, Governor Earl Warren has been presented with the Annual Award of the National Safety Council in recognition of California's outstanding engineering performance in traffic safety activities.

The award was handed to Governor Warren by F. M. Carter, Western Director of the Institute of Traffic Engineering, at a brief ceremony at the Fairmont Hotel in San Francisco which was a part of the second day's program of the Western Association of State Highway Officials.

In presenting the award, Carter said:

"Governor Warren, California again, under your leadership, has distinguished itself in its efforts toward the problem of national highway safety. During your administration and through your efforts, the Collier-Burns Act has provided the means for accelerating the State's efforts to make driving on our highways safe.

"For years the National Safety Council has evaluated the programs of highway safety as between states and has recognized those outstanding states with appropriate awards. Recently, the council regrouped the states, through its committee of judges, of which Mr. Thomas H. MacDonald, Commissioner of U. S. Bureau of Public Roads, is chairman. California was placed in that group which includes the most thickly populated and heavily trafficked states: New York, Pennsylvania, Ohio, Illinois, Michigan, Indiana, Texas, and California. In each year's evaluation, the judging of the question of improvement in traffic engineering has been conducted by the National Safety Council through the Institute of Traffic Engineers, a nation-wide professional society composed of state and city traffic engineers.

"In the years 1947 and 1948, California won first place in traffic engineering as against the Eleven Western States. Plaques of recognition were presented to the State by the Institute of Traffic Engineers. In the year 1950, California again has won recognition as that state of the eight most thickly populated states which has shown outstanding engineering performance in traffic safety activities.

"As a director of the Institute of Traffic Engineers, it is my very great pleasure, on behalf of that organization, to present to you this award in recognition of California's outstanding accomplishments in traffic engineering."

CEMENT TREATED BASE CONSTRUCTION IN CALIFORNIA

By EARL WITHYCOMBE, Assistant State Highway Engineer

(Presented at WASHO Conference June 25, 26, 27, 1951, by Mr. Withycombe.)

California lays no claim to having contributed in originating the successful use of cement in the treatment of soils and bases. Much to the contrary, California was one of the first to demonstrate that cement as a treatment to subgrades was an unsuccessful procedure.

The use of concrete as a pavement type in the interior valleys of this State began in 1914. In this earlier construction the subgrade consisted of whatever material was encountered in excavation, which in a great many instances was the highly expansive valley clays commonly known as adobe. These clays possess a lineal shrinkage in excess of 10 percent. Early in the life of these pavements it became evident that the destructive effect of the subgrade was far greater than that of traffic. Much thought was given to subgrade corrective measures, and in 1921 a day labor project was set up in connection with a going contract for the paving between Denverton and Rio Vista to provide admixtures with the native adobe of portland cement, hydrated lime, limestone and bitumen.

30 Years of Service

A condition survey was made in 1924 which disclosed no visible evidence of any benefit from any of the subgrade treatments and interest in the study ceased. In April of this year it was decided to investigate the condition of the soil treated with cement after 30 years of service. Cores were obtained of the subgrade which indicated that the original construction had been so poorly conducted that none of the subgrade could be considered as having been treated in the manner contemplated. To those of you who have attempted to mix cement with tenacious clays, the reasons are understandable. The mixing process had

EARL WITHYCOMBE

been so crude that pure cement was found in thin lenses and there was little apparent intimate mixture with the subgrade soil. The very interesting disclosure in the investigation was that no evidence of deterioration of the cement treated mixture was apparent where the cement had been properly incorporated.

1938 Experiment

In 1937 California became interested in the Texas work with low cement content pavements with the object in mind of creating a better base for bituminous surfacing than was afforded by the rock bases in use at that time. In 1938 a contract was let for the construction of a section 0.95 miles in length in which the specifications provided the concrete be designed on a strength basis rather than a fixed cement content in which a minimum of 450 pounds per square inch flexural strength at seven days with not less than four sacks of cement to the cubic yard were the controls. It was found that the minimum strength could be obtained with three-sack concrete and two 500-foot sections were constructed with the reduced amount of cement.

It is interesting to note that the three-sack concrete, representing a cement content of 7½ percent by weight of the dry aggregate, is after 13 years carrying moderate traffic without the need of a surface cover. Ten-day cylinders for the three-sack concrete averaged 850 pounds per square inch compressive strength and the 11-year cores averaged 4,347 pounds.

California Develops Process

Not too much enthusiasm was exhibited at the time over this one and only experiment with low strength concrete. The use of cement in treating sands was receiving much national publicity. During the same year a short section of sandy silt subgrade for bituminous surfacing in the vicinity of Macdoel was treated with cement by the then generally used farm equipment mixing method. The following year three other projects in scattered locations were similarly treated.

At this point in the history of cement treatment California lays some modest claim to being instrumental in the development of the process. Adoption of the idea was spontaneous and it was hurriedly fitted with long pants and brought along to the point wherein 283,000 barrels of cement were used for such purposes in the calendar year 1950, in this State alone.

It was during the 1940 construction season that the antiquated farm machinery was abandoned and plant mixing or mixing with modern traveling pug mills was adopted. Standard procedures for the control of cement treated base construction were worked out under the able direction of former Materials and Research Engineer Thos. E. Stanton and his successor Francis N. Hveem. Briefly, the procedure consists of fabricating the specimens four inches in diameter and approximately four inches in height. The mold con-

tains a tin liner in which the mixture is placed in two layers, each layer being rodded by hand, after which the mold is placed in a frame and load applied by means of a hydraulic jack to 25,000 pounds and held for one minute before releasing. This procedure is used to determine optimum moisture, maximum test density, and to fabricate test specimens.

Loss of Moisture

During the process of fabrication, notation is made of loss of moisture squeezed our of the specimen. The amount of this loss is determined by weighing immediately before and after application of the static load. I wish to call particular attention to this feature of the control. A small amount of excess moisture must be present in nearly all mixtures to insure maximum compaction which goes hand in hand with the maximum strengths obtainable with the amount of cement being used. When strengths fall off on a job under construction, our first thought is to examine the test report for the moisture indication. The upper limit of excess moisture is readily determinable in the field. Isolared areas of quaking or jellying during consolidation is a clear indication that detrimental excess moisture is present.

The measure of consolidation in place is determined by excavating a sample from the finished construction and measuring the space by means of a sand volume apparatus. Dry weights per cubic foot are compared with the fabricated specimen and the relation expressed in percentage of compaction.

Uses

Cement treotment in California is used for three distinct purposes, nomely:

(1) To provide an economicol pavement foundation of limited slab strength greater than that of the naturol material but less than that of concrete povement.

(2) To solidify subgrades for concrete pavement and moke them resistant to displocement or to erosion in the presence of moisture under the rocking action of slabs as a result of curling.

(3) The addition of low cement contents to foundation materials to overcome high expansion qualities or to increase sheoring resistance.

Cement Treoted Boses

Cement treated bases are set up on

R. M. GILLIS

a strength requirement. Present practice is to design on 650 pounds per square inch at seven days. This is usually obtained with cement contents varying from 4 to 7 percent. Determination of the cement content in base mixtures as well as all other types of cement treatment is based on laboratory investigation of the materials in advance of writing specifications for the project.

In the early stages of cement treated base construction the tendency was to design on a rather high cement content and accept whatever strengths that these produced. As a result it was not uncommon to have 28-day strengths run as high as 2,000 to 3,000 pounds per square inch. This led to unsightly contraction cracking in a considerable number of instances, both longitudinal and transverse, that were transferred through the bituminous surfacing and frequently resulted in objectionable surface spalling.

After making a survey of the mileage placed at the time, a strength of 650 pounds per square inch at seven days was decided upon as that at which contraction cracking ceased to be objectionable. Our specification was drawn up accordingly in which it is required that the mineral aggregate in combination with the specified amount of cement shall produce the above strengths. This would indicate a minimum strength only, but in the practical administration of rhe specification it serves more or less as a maximum also. When job strengths indicate that the minimum is being materially exceeded the cement content in the mixture is reduced accordingly. This can readily be done as cement in all mixtures is set up as a separate contract item.

Remorkoble Success

One of our earliest uses of cement for base construction was to correct a bituminous macadam pavement that was failing by reason of the plastic qualities of the filler in the rock base course. In this instance, the surface course was mixed in with the base following which cement was added and the combined mixture relaid as a base for a new bituminous surface. Many similar projects have been so treated since that time with remarkable success. Pavements that were being pounded to pieces by concentrated log and lumber hauling have been so treated and are serving satisfactorily under continued similar traffic.

Rother than sacrifice the volue of the bituminous surface by mixing it in as o port of the new cement treated base, experimental work on o job-size scale was recently conducted of breaking up bituminous surfacing, crushing it to the original sizing of the aggregote, adding o highly oromatic solvent, remixing ond relaying as a surface course. The success of this work indicates thot bituminous povements that are foiling from plosticity of the base course can be torn up, remixed ond relaid without the addition of ony aggregote other than the cement. This should result in moteriol savings in the reconditioning of some of our older povements.

Vorious Mixing Methods

When aggregate is to be imported from an outside source, cement treated bases are usually required to be built by the plant-mix method. The road-mix method is specified when the aggregate comes from multiple sources or when treating the material in place. Continuous mixing plants have been used quite extensively in recent years on this type of work and productions of 250 tons per hour are not uncommon. Road-mixing is permitted only by the use of approved road-mixing ma-

chines corresponding to the types generally used for bituminous work. In order to insure the maximum strengths obtainable with the amount of cement being used, a time limit is provided for the interval between mixing and completion of finish rolling of not to exceed two hours.

Spreading of plant-mixed material is performed by the use of various ingenious devices but most commonly with spreaders generally employed for bituminous work.

Compaction of Bases

Compaction of cement treated bases is obtained with 12-ton three-wheel rollers for which we have yet found no substitute. We do not permit the use of a sheepsfoot roller due to the distortion of the surface and to the time consuming factors involved. Field compaction is required to be not less than 95 percent of that obtained in the samples fabricated under static load of 25,000 pounds.

After the desired compaction is obtained the surface is shaved with a blade grader to profile tolerances of not to exceed three-eighths inch deviation in 10 feet. Final rolling follows immediately behind the cutting by means of a pneumatic-tired roller along with water applied through atomizing nozzles. This imparts a dense, close knit surface of even texture.

Immediately upon completion of the final rolling a curing seal of approximately 0.2 gallon per square yard of asphaltic emulsion is applied. The base is then ready for surfacing as soon as the seal is sufficiently dry.

Cement Treated Subgrades

The added increment of truck loadings on our highways during the war years in the interest of the defense effort resulted in an epidemic of pumping and stepped-off concrete pavements the correction of which presented a serious drain on current finances. Measures that had to be taken to prevent the action of rocking slabs from being transmitted through the bituminous resurfacing often resulted in an expenditure greater than the first cost of the concrete pavement.

. . . Continued on page 43

Praise for Convention Management

Governor Warren congratulates George S. Pingry, convention manager, while Robert E. Reed, on Governor's left, Chief Counsel, and Frank B. Durkee, Deputy Director, now Director, California Department of Public Works, smile their endorsement

Delegates to the WASHO convention were unanimous in their praise of George S. Pingry and his staff for the efficient manner in which they managed the meeting and the entertainment provided for those in attendance.

Before adjournment, the convention adopted the following resolution:

"WHEREAS, The Thirtieth Annual Conference of the Western Association of State Highway Officials has assembled in San Francisco, California, and enjoyed a most profitable business meeting of the association; and

"WHEREAS, The usual hospitality of the great State of California has been exceeded in this particular instance; now, therefore, be it

Resolved, That the President of the Western Association of State Highway Officials express to the State of California, Department of Public Works, Division of Highways, the sincere thanks and appreciation of the delegates to this conference for the splendid handling of the tremendous detail of the conference as well as the most generous hospitality that was extended."

Pingry, Assistant Chief Right of Way Agent, District IV, worked for weeks making arrangements for the convention. His assistants before and during the sessions were Mrs. John H. Skeggs, Ladies Section; R. P. Duffy, District Construction Engineer, Transportation, and B. W. Booker, District Engineer, Men's Freeway Bus Tour.

Aileen Moriarity was in charge of the convention registration desk and her staff was composed of Stella Biedenbach, Marilyn Kennedy, Jo Stevenson, Mary Pingry, Janet Puccinelli, Jean Kornahrens, Margaret Tucker, Mary Hyde, Shirley Della Maggiora, Helen Zupan, Information.

Continued from page 42 . . .

A conditional survey of this damage disclosed that it was more or less prevalent on all of the trunk highways within the State. Specific sections were singled out for further study and from these studies came the recommendation to adopt some means of subgrade solidification in new construction, particularly in those materials that have a record of being susceptible to pumping or displacement. Cement offered the greatest promise and has been largely used for this purpose.

Economical Methods

For reasons of economy in utilizing the treated material mixing is specified to be performed after the side forms are in place and the subgrade cut to section. The road-mix method is permitted for this reason. A four-inch thickness was decided upon as a standard to insure appreciable depth at all points. The amount of cement usually ranges from 3 to 5 percent. Strength requirements are not specified for this type of work but the recommendation for design purposes is approximately 300 pounds per square inch at seven days.

This type of subgrade treatment requires the placing of side forms sufficient for two days run in advance of the mixer. Normally, subgrade prepared one day is covered with pavement the following day; however, no prohibition is placed on covering cement treated subgrade with pavement immediately upon the drying of the curing seal.

Thickness Not Reduced

Although this treatment no doubt adds materially to the structural strength of the design, we have not attempted to reduce the thickness of the superimposed concrete pavement. The first of this type of subgrade was constructed in 1945. None of the pavements laid over such subgrades has shown any tendency to pump or step-off. This might appear to be a rather extravagant measure to prevent subgrade displacement and subsequent pavement distortion; however, our experience with corrective measures in stabilizing rocking slabs is that the cost may range from $20,000 to $50,000 per mile. The cost of the cement treatment of subgrades averages $4,500 per mile for two-lane pavement.

In the construction of cement treated subgrade the contractors generally equip the job with a continuous train of machinery with which to scarify, pulverize, spread cement, mix and layout the finished product in one operation. Compaction, trimming, and application of the curing seal follow closely behind these operations. The entire procedure being identical with that required for road-mix cement treated base. With good organization this work has been carried out without any delay to paving operations on projects employing 34-E dual-drum pavers with a capacity of 1,300 cubic yards of concrete per eight-hour day or the equivalent of 4,400 lineal feet of single-lane pavement.

Treatment With Low Cement Content

A considerable mileage of pavement foundation has been constructed with low cement contents ranging from 1 to 2½ percent. These treatments are to strengthen local materials and make the importation of costly high quality base unnecessary. By this means materials without excessive plastic qualities can often be made the equivalent for pavement foundation of the standard types of rock bases and at a considerable saving in over-all costs.

The practice of importing materials of a better or more uniform quality than the native soils for the upper layers of the roadbed has been practiced by California for a great many years. Usually the source of such imported borrow is determined in advance and the specifications insure the bidder that acceptable materials are available at these locations. Frequently, preliminary sampling fails to disclose the presence of adverse material and some of it is placed on the roadway before it is disclosed by check tests. This usually can be corrected by the addition of small percentages of cement which can be provided under extra work financed from the project contingency fund.

Option of Contractors

In setting up specific locations from which to obtain material for the foundation layers the contractor has the option of selecting any substitute source of his choosing providing it is of equal quality. Contractors have added cement to local material sources at their own expense in order to make acceptable a material that was more economically located than the source designated by the State.

The question was raised as to the uniformity in distribution of cement by the road-mix methods when low percentages were used. Extra cement as a factor of safety was advocated. To insure uniformity in this respect the feature of cement distribution is made the subject of check from time to time on all projects. Cross-sections of the mixed windrow are obtained by sampling from both sides and the center and fabricating into individual samples for testing. Comparative strengths of these samples are accepted as the measure of uniformity of mixing and the uniformity between cross-sections is accepted as the measure of efficiency in spreading cement. When this procedure was placed in practice we began to find out things about mixing equipment.

We have satisfied ourselves by these methods that we can successfully mix cement with fine-graded materials such as silty sands with as little as one-half of 1 percent of cement.

Strength is not a requirement with low cement content mixtures and they are treated in the same manner as any other embankment material except that the rate of compaction is reduced from 150 cubic yards to 100 cubic yards per roller hour. Compaction is specified to be not less than 95 percent of that determined by the impact or field method compaction test developed by the department to measure the consolidation of embankments. The amount of cement to be added and the control testing of the mixture are both determined by the stabilometer.

It might appear from the foregoing that California has gone all out for cement as a general cure-all. Such is certainly not the case. Cement treatment is far from being a cheap form of construction and in considering its use the benefits to be gained must be carefully weighed against the cost. The proper use of cement is filling a long-time need and very definitely has a place in highway construction and maintenance.

IMPORTANCE OF HIGHWAY CONSTRUCTION TO THE NATIONAL DEFENSE EFFORT

By R. H. BALDOCK, State Highway Engineer of Oregon *

When the strategic network of military highways was selected prior to the second world war, it was found that the roads that are the most vital to the peacetime economy are likewise the roads deemed most necessary in time of war. Unfortunately, during World War II, highways were regarded by many of the national authorities as expendable, and the Nation has not yet been able to restore the highway deficiencies resulting from this mistaken concept.

The report of the Joint Economic Committee of the Eighty-first Congress, prepared with the cooperation of the Bureau of Public Roads and the state highway departments, entitled "Highways and the Nation's Economy," found that more than 9,000,000 persons are employed directly or indirectly in highway transportation industries, that many businesses depend solely upon the patronage of the motorist, and that almost all commodities are transported, in part at least, by motor trucks.

Roads Affect All People

In fact, roads affect intimately the lives of all people. They are necessary in peace and vital in war. Highways facilitate and make possible the delivery of military equipment, materiel and supplies by enabling the expeditious movement of materials from the farm, the mine, and the woods to the factories and the processing plants; and, second, by moving the goods from the factories to the shipping points.

In the first world war, vital transport of this Country nearly broke down because it was almost entirely supplied by rail. During the second world war, much of the traffic moved over the highways, but they suffered greatly from the wartime impact and the wounds have not yet healed. Highways

R. G. BALDOCK

are, in effect, the Nation's first line of defense, and the rebuilding of deficient highways and the maintenance of the present highway system is a most vital need of our present defense economy.

Indeed, the pace of the global "cold war" has materially stepped up during the past 10 months, while the "police action" in Korea has become a major conflict. War is basically a struggle to keep transportation lanes open and functioning efficiently on land, on sea, and in the air.

Motor Vehicle Transportation Vital

Headlines point to the spectacular achievements of combat forces, but the vitally important work of military transport vehicles back of the front and the civilian and industrial transport of all sorts in the noncombatant areas in this Country is generally forgotten. It is no exaggeration to say that the production front in this Country is so dependent upon motor transportation that, if it fails or is seriously impaired, the industrial paralysis may be fatal.

For over 40 years our American economy has become increasingly dependent upon motor vehicle road transportation. At the present time there are approximately 50,000,000 motor vehicles in the United States, of which nearly 8½ million are trucks, busses and pickups; 71 percent of the families own passenger cars.

Dependence of Rural Areas

Nearly 50 percent of all our population living in rural areas is almost entirely dependent upon private automobiles for transportation. Over 50,000 communities are without railroad service, and some 2,500 towns do not have any means of mass transportation whatsoever. Large numbers of the population have moved from the dense urban areas to homes in the rural areas, meanwhile continuing to gain their livelihood in the city. These people have built their social and economic life entirely around the automobile because the sparseness of the commuter population does not justify mass transportation to the degree that is necessary to give the service required.

Large numbers of small plants that are being used in the present defense effort are entirely dependent upon motor truck shipments for their continued operation.

There is an inherent advantage in motor transportation over any other form of transportation yet devised. It has an outstanding physical flexibility due to the characteristics of the motor vehicle which can travel almost anywhere. There is a wide range of vehicles to fit a wide range of needs and a minimum number of transfers of freight, passengers, mail or express at intermediate points, while topographical obstacles are overcome much more easily by motor vehicle than by rail

* Mr. Baldock delivered this address at the WASHO Convention in San Francisco.

transport. Service is provided to numerous points to which transportation cannot be provided economically by any other means.

Importance of Motor Transport

Motor transport is tied intimately into the business and social lives of all people. Nearly 80 percent of the farm trips are for necessary uses. It is vital to the livestock industry. No one thinks of driving cattle overland any more.

It is necessary to the milk industry, to all types of agriculture, and to the mining industry. Without motor trucks, there would be virtually no lumbering today. The truck logger is starting in where the railroad operator quit. He tackles country of such rough topography that rail lines could never be built.

The National Highway Users Conference recently wrote to Charles E. Wilson, Director of the Office of Defense Mobilization, and told him that the critical condition of the Nation's highways must be speedily corrected if our national defense effort is not be seriously handicapped. They asked him to recognize the essentiality of highway transportation, including an accelerated highway improvement program and the appointment in the Defense Production Administration of a person experienced and competent in highway transportation as a high level adviser to analyze highway problems and to develop policies and programs that will insure adequate and efficient transportation services in the present emergency.

Lack of Highway Capacity

In 1949 the Hon. T. H. MacDonald, Commissioner of Public Roads, said:

"The most serious deficiency of our highways today, not only the interstate system, but others of greater or less importance, is their lack of capacity to provide for the ever-increasing number of motor vehicles in service. This year the production of motor vehicles at present rates will range well above 5,000,000 units. With a substantial allowance for vehicles taken out of service, the increase of vehicles in use, if it could be formed into a moving column, would stretch over 27,000 miles, or once around the world at the equator and 3,000 miles further on a second lap. The use of motor vehicles is the direct support of three of our major industries, without reference to the ancillary spread into numerous other elements of our economy. It seems unnecessary to argue that the annual addition of increments to highways, if overloaded and unsafe, cannot be continued at current rates without major enlargements and increases in the highway systems.

Deficiencies Acute

"Because of the concentration of traffic on the interstate highway system the deficiencies are acute, particularly within the urban areas, but these inadequacies extend to the remaining mileage of the Federal Aid System, rural and urban, to many miles of the secondary Federal Aid System, and to other roads not included. If we are to have roads that are safe, and if we are to obtain the utility of the motor vehicle with economy, it is necessary to have a program of reconstruction, rehabilitation, and extension of highways consistent with the number and types of motor vehicles now in service, to which extraordinary additions are being constantly made."

Recent speakers at the annual meeting of the American Road Builders' Association, held in Milwaukee, Wisconsin, March 12th-14th, expressed the idea in different ways, but it comes around to the same thing.

"I do not consider it intelligent preparation for defense," declared U. S. Senator Dennis Chavez, Chairman of the Senate Committee on Public Works, "to permit highway transportation to deteriorate in any degree. The main highways are the assembly lines of a large portion of our defense plants. Raw materials move over the highways to plants. Parts for weapons and machines move from one plant to another for processing. We must feed, clothe and house our war workers and all the rest of our population. Usage of highways must continue for these purposes."

Need Highways in War and Peace

"Our military strength," said E. R. Needles, outgoing President of the A. R. B. A., "is largely measured by our industrial strength. We cannot have fewer cars, poorer cars, fewer trucks or even lighter trucks if our people and our industries are to be served as they should be, and if our military strength is to be built up and fostered. We need more and better highways, in war as well as in peace, if we are to remain strong and efficient as a Nation."

"A highway system cannot be considered expendable," asserted James A. Anderson, State Highway Commissioner of Virginia and President of the American Association of State Highway Officials, "for it would not be possible to replace or repair it quickly, even if the costs in money, manpower, materials and equipment could be spared from other defense needs. Pol-

RESOLUTION NO. 4

WHEREAS, The Congress of the United States is now considering a proposal of the House Ways and Means Committee to increase the federal automotive excise tax on gasoline, diesel fuel and other components of highway transportation, such levy estimating to yield in excess of one-half billion dollars annually; and

WHEREAS, Highway users are already contributing one and one-half billion dollars annually in World War II excises that are still in effect; and

WHEREAS, Under said proposed increase the highway users of the eleven Western States and Texas will contribute $200,000,000 annually in gasoline and diesel fuel excises alone; and

WHEREAS, The field of automotive taxation is one that historically and rightfully belongs to the states, and is their principal sources of revenue for construction, maintenance and patrolling of highways, including matching of federal aid for highways; and

WHEREAS, Further encroachment by the Federal Government into this field of taxation would interfere with the taxing potential of the states for highway construction and maintenance essential to our national security; and

WHEREAS, The development of the western region has been geared to the growth of highway transportation where many communities are entirely dependent on highways and automobile, truck and bus transportation; and

WHEREAS, These proposed increased excises are discriminatory because they are to be imposed on only one form of transportation—highway transportation—and will place all of its components in a "luxury" classification along with many admitted nonessentials; now, therefore, be it

Resolved, That the Western Association of State Highway Officials, meeting in San Francisco, California, on July 28, 1951, hereby voice their opposition to any increase in said excise taxes; and, be it further

Resolved, That copies of this resolution be forwarded to the chairmen of the House Ways and Means Committee and the Senate Finance Committee and other appropriate officials urging strenuous opposition to these unjust and discriminatory increases.

icies adopted should assure reasonable protection of our highly essential highway system."

Forthright Warnings

A. C. Clark, Deputy Commissioner of Public Roads, called attention to the fact that the states are not building new roads but are replacing present highways that are worn to the extent that they are no longer able to handle the fantastically increased number and weights of traffic. He pointed out that our job is not the building of new roads but the keeping of the vast highway plant in operation. He stated that before this emergency came along the highway maintenance already had reached a point of diminishing returns because of too little being available for road modernization.

These forthright warnings were reinforced by the experience of the past war period in which partial crippling of the highway plant had resulted from a failure of understanding. Yet at Milwaukee, somehow, as reported by *Better Roads*, one felt an undercurrent of the uncertainties that clouded the meetings of 1940 and 1941. What materials *would* be readily available, and for how long? Would the habit of neglect slip into its old place? The spirit was resolute, but the doubts hung on. Failure of the National Production Authority to grant reasonable priorities for steel needed for highways is difficult to understand. This error must be rectified at once.

Action Expected

It is hoped that the National Production Authority will soon issue an order designating the Bureau of Public Roads as their representative in the administration of the control of the allocation of critical materials. It is expected that some such action will be taken after the first of October, as otherwise the highway work will largely come to a standstill.

The arguments for the necessity for highways for both our peacetime and our wartime economy are unassailable. No one entirely discounts them, but everybody expects the highway engineer to "pull a rabbit out of the hat"—be able to get along some way. It must be admitted that the highway engineers have done a good job, particularly those in charge of maintenance, because of their past ability to keep a highway system operating in the face of increasing traffic, increasing loads, increasing costs, and relatively decreasing revenues, but, unless many sections can be rebuilt shortly, bottlenecks may develop.

WASHO Vice President A. M. Nash

Problem of Maintenance

The people in charge of priorities for essential materials may admit the essentiality of highways, but they do very little about giving the highways the requisite materials to build the roads so necessary for the defense effort. It can't be done by maintenance alone. The maintenance engineer is run ragged now trying to keep up with the tremendous depreciation caused by the last war. He is trying to maintain critical deficiencies that have reached the point where reconstruction is absolutely necessary, and witout this reconstruction the maintenance money will be poured down a rathole.

The trucking industry, which vitally needs highways for the movement of its vehicles, is continually fighting with highway administrators to lower taxes and to increase weights. I have seen no effort on their part yet to help to secure the priorities for essential materials so necessary to make the highway improvements to provide the necessary roadbed for their vehicles. We would welcome that help. On the contrary, some of their spokesmen allege that the highway engineers are not competent—that a body of men who have spent a lifetime in the building of roads do not know their business. It is high time that they realize the basic necessities of the highway program and help the highway departments to get the money and the materials to carry out these needs. We must have better cooperation. Everyone should get over his "pet peeve" and make an intelligent appraisal of the facts bearing on the situation. Everyone must also realize that no wartime necessity will justify the destruction of the highways, which would certainly break down the entire defense effort. It may even jeopardize the security of this country.

Knudson's Request

On March 8, 1951, Mr. James K. Knudson, Director of the Defense Transport Administration, wrote a letter to all the governors in which he pointed out the vital need of transporting by truck essential goods needed in the war effort, the shortage of equipment to do the work, and the need to load the equipment to the maximum possible extent. He asked that they set aside the barriers at state boundaries and permit the movement of vehicles of greater size and weight and called attention to the uniform standards on sizes and weights promulgated by the American Association of State Highway Officials. However, he asked that this AASHO code serve as a minimum rather than a maximum standard during the emergency.

We all know that very careful review of the situation by the association evidenced that this should be the approximate maximum standard. Mr. Knudson asked the states whose present limitations are below the code requirements to raise their standards to the code minimum but requested that there be no reduction of the existing size and weight standards of any state that now exceed the AASHO standards. He requested cooperation and assistance in holding to an absolute minimum the spring thaw restrictions to permit the operation of fully loaded trucks where it would be dangerous and unwise to operate them only partially loaded.

States' Rights

No one has yet been able to control the weather, and the imposition of heavy loads when the frost is leaving the subsoil may rupture the pavements and cause such damage as to seriously

MAINTAINING A SOUND HIGHWAY PLANT*

By THOS. H. MacDONALD, Commissioner of Public Roads

There is general acceptance of the fact that confronted by conflicts of economic and political philosophies, world-wide in scope, our central objective must be to build and to hold the strength of this Nation far above any level previously reached. To achieve this purpose every concept that has a major influence in determining public policies must be reviewed for its integrity and discarded if it is found false. Present conditions within the Nation provide fertile fields for the growth of false and dangerous concepts with reference to the highway program. Some of these are old but some are more recent.

Highways, including streets, are an essential element of our whole transportation system. Without highways the system cannot function as a complete service, that is, origin to destination. Regardless of how efficient or how adequate other forms of transport may be, the service of transportation of either people or goods begins and ends on the highways and streets. Because highway construction and maintenance are a public responsibility and carried on by public officials, the attention of the public is generally focused on the highway program as such, rather than on the end product which the highways make possible, that is, transportation. By such shortened vision the trees are seen and the forest fades to a blur.

RESOLUTION NO. 5

WHEREAS, The vast areas of mountainous and wild land of the western states are the source of water for our communities, our industries and our agriculture; and

WHEREAS, Well vegetated and healthy watersheds tend to regulate runoff; and

WHEREAS, Denuded watersheds accelerate runoff and erosion and increase probability of damage to highways and bridges and may cause untold damage to other property; now, therefore, be it

Resolved, That this association go on record as urging increased efforts by all agencies and persons concerned to protect our watersheds from fire, overcutting, overgrazing and other forms of abuse and to work toward restoring damaged areas; and be it further

Resolved, That copies of this resolution be forwarded to the United States Department of Agriculture, United States Forest Service, United States Department of the Interior, United States Bureau of Land Management, and the Governors of, and the Members of Congress from, the western states.

Vast Mileage

There is also the carry-over from the days when the highways were brought into the unemployment relief category. There are those who would defer highway construction now to await another like period of unemployment with never a thought to the functioning of transportation as an essential factor in making possible employment at high levels.

We have a vast mileage of public highways—3,322,000 miles in all. Of this total, 2,574,000 miles have been graded and drained or have received a higher degree of improvement. This mileage would circle the earth at the equator 100 times. Every mile is of importance to some segment of the population and for some purpose. The task of the highway officials of the country then is to keep this mileage available for use, and the operations which make this possible are constant maintenance and periodic rehabilitation.

The service life of roads is dependent upon the type of the improvement and the amount and kinds of traffic using them. It would be possible to assign a well authenticated length of life to the different types of road surfaces and thus arrive at the rate of replacement

* Address by Mr. MacDonald at Thirtieth Annual Conference of the Western Association of State Highway Officials, San Francisco.

---

impair the state's economy as well as to prevent the movements Mr. Knudson desires. Mr. Knudson stated that this problem could either be dealt with through the adoption by the states of a uniform regulatory code or by federal action in this field. It would be both absurd and unfair for the Federal Government to act in the field of weights and dimensions of motor vehicles without at the same time assuming the responsibility of maintaining the highways which the states now have. This is an invasion of states' rights which should not be tolerated.

It is apparent all through Mr. Knudson's letter that he fails to understand the basic concept that motivates the state highway engineer, and that is the building of highways to serve the greatest number of people and to permit the moving of the maximum size and load that the facilities will permit. There is a maximum load to which the facility can be designed, because there is a limitation on finances and because of the further fact that increases in design would result in extra costs far beyond the payment of the small segment of the trucking industry which would benefit therefrom. Most states are now designing for reasonably heavy loads, as represented by the AASHO code, but we must face the condition that the majority of the loads have to be carried over the roads that we now have. These roads will rupture when certain overloads are applied. There is no possible way to repeal or temporarily set aside the law of gravity.

It is indeed high time that all of us—highway departments, trucking industry, Defense Transport Administration, and the general public—approach this problem intelligently and endeavor to restore the alarming critical highway deficiencies which are, in the main, due to the beating that the roads took from the heavy traffic of World War II. These critical deficiencies of the primary federal aid system of this country now equal 22 billions of dollars.

It is necessary that we do more than maintain the highway system. We must restore the critical deficiencies as part of the defense effort in order that the road system may carry the tremendous load that this present defense effort will impose. We have no time to lose. The emergency is now upon us.

or rehabilitation necessary per year to keep the highway plant in reasonable operating condition. To focus more closely on the problem suppose we look at only a percentage of the total—357,000 legally designated miles under jurisdiction of the state highway departments which constitute the primary rural state highway systems.

Rate of Surfacing

The rate of surfacing of these systems has been carried forward as follows:

	Average of miles per year
1922-1931, 207,255 miles	20,725
1932-1941, 230,804 miles	23,080
1942-1949, 128,617 miles	16,077

For the past three years the rate of surfacing on the state primary system (rural) has averaged 23,675 miles per year, approximating the same rate as the 10-year period 1932-1941 inclusive. The total rural surfaced mileage as of January 1, 1950, was 344,458. The most reliable figures we have indicate that in 1921 there were 84,000 miles of surfaced highways, so we have gained through the period approximately 260,000 miles of surfaced roadway on our primary state systems.

Over a 28-year period the annual average is 9,300 miles. But we have built in 28 years, 567,000 miles of surfaced roadways, or 20,000 miles per year, which means the reconstruction of 307,000 miles total, or 11,000 per year. Thus, we have been working for three decades on a 31-year cycle of replacement for our main road surfacings which is far in excess of the life expectancy, and added to this gloomy picture is that, as engineers, we know the replacements have largely not been adequate in the modernized details of design to meet the demands of the rapidly multiplying traffic. This fact presents the red flag of warning of how dangerously close we are to losing the struggle to keep the main system of roads in operation at the present rate of rehabilitation. This same general situation exists on secondary and local rural roads with a more exaggerated lag in the rate of replacement and a consequent higher maintenance expenditure.

RESOLUTION NO. 6

WHEREAS, The national forests of the United States have vast resources of water, timber, minerals, grass, wild life, fish, scenery, and provide livelihood and recreation for millions of people; and

WHEREAS, The utilization of these resources and their protection from fire and pests requires a network of many thousands of miles of forest development roads and highways; and

WHEREAS, Many of the resources of the national forests return a large revenue to the Federal Government; and

WHEREAS, Most states and counties are financially unable to construct or maintain the roads necessary for the forest system; and

WHEREAS, Current appropriations by Congress for forest highways and forest development roads have been far below the amounts authorized by Congress; and

WHEREAS, With the rising costs, it has become impossible to provide needed road facilities in the national forests; now, therefore, be it

Resolved, That this association go on record as urging the Congress of the United States to appropriate such sums for forest highways and forest development roads as are now authorized under existing legislation.

Program Out of Balance

We have indeed failed to balance our highway transportation program between adequate roadways and new motor vehicles. The figures which are quoted as the annual rate of placements of new surfacings and rehabilitations of the existing roadways have remained almost static as an annual average for nearly 30 years.

In the meantime the growth of motor vehicle use is fantastic. Particularly is this true of the growth of truck traffic. In 1904 there were only 700 trucks registered in the entire United States, just 1.3 percent of total registration.

In 1910 the percentage of trucks in the registration was still only 2.2. Percentage figures at 10-year intervals are as follows:

Year	Percent
1910	2.2
1920	12.0
1930	13.3
1940	14.3
1950	17.0

Thus there was a rapid expansion in the proportion of trucks from 1910 to 1920, and a steady increase since that time.

Truck Traffic Increase

In 1929 only about 12 percent of the *traffic* on rural roads was truck traffic, on the basis of the somewhat fragmentary information available at that time. Beginning in 1936, comprehensive traffic volume and weight data have been obtained throughout the Country so that more accurate figures are available. In 1936, truck traffic constituted 18 percent of the total, and by 1949 it had risen to 22 percent. Thus, in the 20 years from 1929 to 1949, the increase in truck traffic was almost twice as great as that of traffic as a whole.

But the most striking, and perhaps the most important development with regard to trucking, has been the rapidly increasing usage of heavy vehicles. Combinations, or vehicle trains, were little used prior to 1930, and no accurate data concerning them are available for these earlier years. In 1936 they constituted 13.9 percent of the cargo vehicles found on rural roads, and in 1949 they constituted 22.7 percent. Because of their greater capacity, these vehicles carry a much larger proportion of the tonnage than their frequency in the traffic stream would indicate. In 1936 they accounted for less than half (43.0 percent) of the total ton-mileage on rural roads, while in 1949 they accounted for about two-thirds (66.1 percent) of it.

Increased Use of Heavy Vehicles

Reflecting the increased use of the heavier vehicles, as well as heavier loading of vehicles of all types throughout the United States, the average carried load increased from 2.5 tons in 1936 to 4.4 tons in 1949. In California an early survey made in 1920 showed the average carried load for trucks to be 1.8 tons. In 1936 the average carried load in California was 3.4 tons, and in 1949 it was 5.5 tons.

From 1936 to 1949, travel on rural roads by vehicles of all types increased from 123 billion vehicle-miles to 216 billion vehicle-miles, a 76 percent increase. During this period truck traffic increased 115 percent (from 22 billion to 47 billion vehicle-miles) and the truck haulage increased 207 percent (from 35 billion to 107 billion ton-miles). Final 1950 figures have not yet

been compiled because data are still lacking from several of the states. However, it is apparent that defense activities have resulted in an abnormal increase in truck usage and carried loads, and it appears that the increase in ton-mileage for the one year from 1949 to 1950 will exceed 30 percent.

Primary Highway Mileages

Again referring to the figures of the development of primary highway mileages, it is evident that a very large percentage of these main roads on which we are dependent today were built in the period 1922-1941. The high type pavements were very largely built after the design adopted as the result of the Bates Road Test in Illinois in 1922 and 1923. The design was based on the legal axle load limit of 16,000 pounds on solid rubber tires which has been equated to the 18,000-pound axle limit on pneumatic tires in the code of the American Association of State Highway Officials. Our roads for the most part will not carry heavier axle loads without excessive deterioration as has been demonstrated by the Maryland test. There is a callous disregard of road preservation by a small fraction of the operators of trucks. This, probably due to a lack of knowledge or a yielding to pressures, extends also to some legislative and other official circles. Excessive loads, particularly excessive axle loads, must be kept off our roads if the whole highway plant is to be kept in operating condition.

Highways for Defense

One of the finest examples of the recognition that our highway plant must be used properly if it is to be kept in operating condition is the transportation policy adopted by the Defense Department. This policy recognizes strict adherence to the state laws for the movement of military vehicles and military cargoes and provides a controlled plan for the requesting of permits for overloads only when military necessity requires. The highway officials of the Country are indeed indebted to the Transportation Corps of the Army and to its Chief, General Heileman, for the initiation and strong support of this policy. In this connection the State and Local Officials Committee of the President's Highway Safety Conference has performed an invaluable service in acting in a liaison capacity between the military authorities and the officials of the states. General James A. Anderson, President of the American Association of State Highway Officials, is the chairman of this committee and General C. Reynolds Weaver is the director.

RESOLUTION NO. 7

WHEREAS, In 1947 and again in 1949 each state was requested to prepare an estimate of needed improvements on the federal aid systems to assist in presenting the highway needs to the Congress; and

WHEREAS, Current and up-to-date estimates of needs will continue to serve increasingly important purposes in portraying the essentiality of the highway system both in times of peace and times of national emergency; be it therefore

Resolved, That the member states of the W. A. S. H. O. expedite the installation of a continuing inventory of needs of the federal aid primary, federal aid secondary and federal aid urban highway systems in accordance with the recommendations of the Finance Committee of the American Association of State Highway Officials.

While the annual rate of rehabilitation of the obsolete sections of our highway plant must be maintained near present levels if our highways are to be kept in sound operating condition, we can cooperate fully with the defense effort by a careful application of criteria in the selection of projects that will best meet and serve defense needs.

Critical Materials

The need for conserving critical materials in an effort to further defense preparations has been increasingly emphasized during the past few months. Obviously, the authorities charged with responsibility for implementing defense mobilization plans have been making sincere efforts to effect an equitable distribution of materials between the military and essential civilian activities. Increasing demands of the military and defense agencies, however, have necessitated more drastic controls and curtailment of civilian activities. As a consequence, the National Production Authority on May 3, 1951, issued an amended M-4 order.

The original M-4 order issued on October 27, 1950, prohibited construction of any projects that would be used for recreational, amusement or entertainment purposes. Other minor amendments followed, but the revised order of May 3d cut straight across the entire construction industry by prohibiting commencement of construction on any project requiring the use of more than 25 tons of steel unless authorization was obtained from the National Production Authority. The only major exemptions related to activities of the Department of Defense, Atomic Energy Commission and the National Advisory Committee for Aeronautics.

It was obvious immediately that the procedure outlined was impracticable for carrying on a program of essential highway construction in an efficient manner.

Bureau of Public Roads Delegated

Conferences were immediately arranged with responsible officials of the National Production Authority for the purpose of securing a delegation of authority for the Bureau of Public Roads to approve projects for construction. Some delay ensued because of the indicated desirability for similar delegations to other agencies in carrying on their respective programs. Finally, Delegation 14 was issued on June 7, 1951, in which authority to approve projects was granted to eight federal agencies. Included therein was a delegation to the Secretary of Commerce in regard to Bureau of Public Roads programs.

On June 7th also, an ad interim redelegation of authority from the secretary to the Commissioner of Public Roads was issued for the approval of construction projects as well as designating the commissioner as the claimant agency for highways. On the same date instructions were wired by our office to the field relative to approval of construction permits by the division and district engineers. Supplemental instructions followed, including criteria of essentiality to be used as a guide in the approval of projects for construction.

Workable Plan

It should be remembered that there has been no waiver of the provisions of NPA Order M-4 but merely a delegation of authority to approve commencement of construction. We now have a workable

plan under this order to insure a continuance of essential highway construction, and the application of criteria to the selection of individual projects should not be done in a perfunctory manner. Steel is scarce and we will cooperate in the conservation effort by utilizing it only for the advancement of the defense effort and for the maintenance of a supporting civilian economy.

Up to the present it is our opinion a fair share of the available steel has gone to the highways, since there remained a quota in the supply for unrated orders. During the second quarter, many of the larger states did not request priority assistance to any extent because of their ability to obtain so-called "free" steel.

RESOLUTION NO. 8

WHEREAS, The delegates to the Thirtieth Annual Conference of the Western Association of State Highway Officials enjoyed the privilege of listening to a most able discussion of the importance of highways to the West by the Honorable Earl Warren, Governor of California; and

WHEREAS, It is fully realized by the delegates that the time of a Governor of a great state such as California is constantly in demand and, consequently, that we were most fortunate that Governor Warren took the time to visit with us at this meeting; now, therefore, be it

Resolved, That the President of the Western Association of State Highway Officials transmit to Governor Earl Warren our sincere appreciation of the privilege given us to meet with him and to listen to his splendid discussion on highways.

Steel Allotments

We first received an allotment of steel amounting to 151,000 tons for rolling in each of the months of May and June. However, notice of the allotment for the May rolling was received two weeks after the beginning of the lead time and therefore could not be utilized. DO rating authorizations were prepared in this office and issued by NPA for practically the full amount of the June rolling allotment. Approximately 31,000 tons of this amount, however, have already been revalidated for third quarter rolling because of the claim by some of the mills that the original authorizations were received too late or that they had already accepted their required quota of DO rated orders.

The Bureau of Public Roads, as claimant agency for highway construction and maintenance regardless of financing, has received from the Defense Production Administration an allotment of steel for the third quarter of 1951. Another allotment for the fourth quarter of 1951 is expected before long. While the DPA is cooperating fully with the Bureau of Public Roads in regard to the need for steel in highway construction and maintenance, the quantity allotted is below the requirement estimates which had been developed in cooperation with the state highway departments. The Defense Production Administration, however, is required to balance highway steel requirements against other defense needs.

Controlled Materials Plan

At the present time we are securing DO rating authorizations for the September rolling in accordance with the states' recommendations. Some difficulties have been noted in procuring steel in certain areas even with these authorizations, because some mills are again claiming that they have already accepted their required quotas of DO ratings for the third quarter. We are hopeful that these difficulties will be overcome upon initiation of the controlled materials plan and that an authorization under this plan will truly be equivalent to a cashier's check on a known supply of material.

The controlled materials plan for steel, copper, and aluminum is about to go into effect. The steel allotment made for the highway program is the first step. Regulations 1 to 4 have already been issued. CMP Regulation 5, to be issued shortly, will cover maintenance, repairs, and operating supplies, and CMP Regulation 6 will cover construction. A favorable feature of the CMP is the provision that a claimant agency will secure a letter symbol and have the authority to issue its own suballotments. This should have a tendency to decrease paper work and expedite procurement of available materials.

Replacements Problem

Over 500,000 major units of equipment support the highly mechanized construction and maintenance programs on the essential highway transportation systems. The replacement of worn-out units and the acquisition of sufficient repair parts and supplies to keep the existing fleet operating is becoming increasingly difficult.

Early this year, the bureau presented to the Defense Production Administration estimates of quarterly requirements for highway construction and maintenance machinery and replacement parts. The bureau, as claimant agency for highway construction and maintenance has also been initiating spot priority assistance for the purchase of essential construction and maintenance equipment as well as the various kinds of scarce materials other than steel. In this we have had the full cooperation of the National Production Authority.

The Bureau of Public Roads has also made definite recommendations to DPA and NPA regarding the serious depletion of the supply of cutting edges for graders, snowplows, dozers, etc. We have asked that a directive be issued to provide the particular steel necessary for the fabrication of these cutting edges. This short supply of cutting edges alone is threatening an immediate work stoppage on some of the 50,000 motor graders and in the fall on many of the 36,000 snowplows. It is hoped that satisfactory solution can be secured for this and other equipment repair parts problems.

Shortages are also developing in the supply of copper cable for traffic control devices and in the supply of titanium and other ingredients for traffic line paints. The bureau is seeking solutions for these problems.

Obviously, we are now operating under a program of austerity. The construction of many desirable projects must necessarily be deferred. More stage construction work should be undertaken and the use of substitutes for critical materials encouraged. Once again we should be alerted to the need for justifying bid prices, especially those for steel which are rising rapidly. Nonessential activities must be curtailed in order to aid the defense effort. We should be fully appreciative of the recognition being given to the importance of highways in the defense program and, in our efforts to maintain this favorable position, we should not fail to recognize the importance of other defense-supporting agencies by demanding a full peacetime quota of materials, equipment and supplies for our highway activities.

PENALTIES FOR OVERRUN OF CONTRACT TIME*

By W. A. BUGGE, Director, Department of Highways, State of Washington

This, according to the program, is the Thirtieth Annual Conference of the Western Association of State Highway Officials, an organization which has performed an outstanding job of promoting technical advances and uniformity in highway matters for our 12 member states. These conferences are of just as much value to us who head our several departments as they are to the assistant engineers we bring along and from whom we gain much of highway wisdom in specialized subjects. I know that we of Washington look forward to the meetings with pleasurable anticipation for the good we will get from them.

"A great transformation in highway building and techniques has occurred since the western association was organized by a small group of western officials 30 years ago.

"Along with the phenominal transformation of highway transportation and design have come multitudinous changes in specifications to define methods of construction and to direct and regulate the operations of the contractor. But over the span of these years there has been little change in the manner of defining and enforcing liquidated damages or penalties for unjustified overrun of time in completing contracted work.

"I am not too greatly convinced that that this is a field for uniformity of procedure by the several states, as is very desirable for many others of our closely related problems, because the conditions which impel over-runs of time are not common, particularly insofar as climatic conditions are concerned. This, in the Northwest, has much to do with overruns and the necessity of authorizing most of the time extensions.

Dubious About Set Formula

"I am likewise dubious that any set formula can be devised to act as a tonic for better time performance without injury to many of our more capable and conscientious contractors who ought not be penalized for the shortcomings of the lesser capable and negligent ones.

W. A. BUGGE

"Whatever we do separately or collectively should keep uppermost in mind the fact that the contracting industry is just as indispensable to heavy construction as the engineering profession, and it must, therefore, be treated with a fairness that sometimes is hardly distinguishable from clemency.

"If we are arbitrary in the exacting of liquidated damages or penalties, regardless of the well-phrased rhetoric of our signed contract, the courts have repeatedly shown they are always prepared under the realities of life to grant relief when it is justified. Our determinations, therefore, should be in the light of the same justice the courts would impose, and ought not be influenced by the timidity or reluctance of the contractor to assert his legal rights.

Overruns Lessen

"With a world of modern equipment to work with and a comparatively lesser amount of labor now required, the number of overruns appears now to be comparatively less than it was some years ago. However, some of these overruns are very irritating, costly to the public, and unnecessary even under average conditions of weather and ordinary supplies of labor, equipment and materials. It is these overruns with which we are concerned in this discussion, and to what extent they are occasioned by the owner represented by us engineers, and to what extent by the contractor himself.

"There is a diversity of ways under which states and other municipalities set up time for completion of contracts. Some of them, of which our State is one, specifies a definite number of calendar days, some set a definite calendar date, and others base the completion date upon a definite number of work, or workable days. Prior to 1937 the State of Washington specified a definite calendar date for completion, but since then the time has been based upon a definite number of calendar days. I am inclined to believe, in view of the complexity of conditions, accentuated by the existing national emergency which promises to be of long duration, that we should consider another shift to 'workable' days.

Completion Dates

"Fixing a definite completion date by either calendar date or by interval of definite calendar days and the collection of substantial liquidated damages is justifiable if the improvement falls in the same catagory as a commercial building for rental purposes or imperative owner occupancy, and every delayed day of its construction deprives the public of its urgent use and necessitates detour or adds to the inconvenience of the highway user. Otherwise, undue haste which ordinarily adds cost, and heavy liquidated

* Address, in part, by Mr. Bugge at WASHO convention in San Francisco.

damages or penalty for overrun, is not so necessary.

"Very often the time for completion is the decision of a single engineer without due analysis of all conditions. Given a half dozen engineers to carefully fix the time on the same project independently of each other and you will have a half dozen different answers, not all of which will have contemplated all the climatic and physical obstacles that will encumber the contractor. The same minute accuracy that dignifies the plans is not, and probably cannot be evolved in setting time limits, but with better analysis of conditions it might well be improved.

Time Limits

"In setting the time limits do we give proper consideration to the fact that it requires same time for any contractor, however efficient he may be, to assemble his equipment, transport and get it in place on the project, and to gather his organization before he can proceed effectively with production? One prominent governmental agency for many years—and perhaps yet as far as I know—specified that the contractor must be working on the project within 10 days of award, and apparently fixed his time limit with that among other considerations regardless of the fact that the official notice to proceed was forwarded by ordinary mail and that the project might be at a comparatively inaccessible location.

"Do we give adequate consideration to the isolation of the project from the labor market and differentiate in estimating time as between the isolated project and the one close to the metropolitan areas? Equipment, once on the project, will work for anyone but labor to run it is nowadays very discriminating. Construction workers of some crafts are not to be found in all areas and must be brought in from other localities. Labor will not employ so readily in these lush days of prosperity to work in the remote regions without special inducements which the contractor cannot give without jeopardy to his relations with the unions from which he must get his labor supply. The most dependable of the crafts want to work no farther from home than will permit driving to and from the work every day and this tends to encumber the isolated project with less efficient help, and more unavoidable delays.

Not Normal Times

"These things, including the normal numbers of 'quits' or 'discharges' and lack of parts, the contractor can generally anticipate by contingencies in his costs before bidding. But these are not normal times; labor and parts become increasingly critical month by month. It follows, therefore, that even though the contractor may have a full complement of equipment and top organization, in face of the unsettled conditions he cannot be expected to very accurately estimate the calendar time he will need for completion and be thereby enabled to include possible penalties within his field costs and proposal.

"As owners, we should not escape our own responsibilities if we expect the contractor to meet his. Therefore, one other thought occurs with respect to what we may further do to reduce the tendency for overruns. Are we advertising our projects in the best seasonal order for some particular classes of construction, or do we let the contracts more nearly in the sequence by which the field surveys and plans become matured and as befits our own convenience?

Make Awards Quickly

"Above all, we ought to make awards as quickly as possible after opening of bids and we should delay the contractor the least possible because of revision of plans when the work is in progress. The reasons are too obvious for further comment.

"We have covered some things which we, as representatives of the owner, can do to lessen the tendency toward overruns. The contractor can do as much or more.

"It would simplify our difficulties considerably if all contractors were of equal management and equipment ability—all on par with the few we consider most efficient—but such is not the condition. We have to take them as they come, subject to their prequalification statements, and even those may be somewhat fictitious. We have learned from experience there is as much difference in contractor management and celerity as there is difference in the ability and alacrity of our own engineers—and that you will agree is quite a bit. Obviously, we cannot expect all contractors to meet the same high performance as the contractor we consider par exemple.

Standard Specifications

"Our own standard specifications provide a deduction as liquidated damages for all engineering costs and other liquidated damages as may be suffered, in a sum not to exceed $50 for each day

WASHO Ladies Provided With Entertainment

WHILE the delegates to the WASHO Convention were busy with their sessions, the ladies in attendance were provided entertainment under the gracious direction of Mrs. John H. Skeggs, wife of Assistant State Highway Engineer Skeggs, of District IV, San Francisco.

On Monday afternoon, they were taken on a personally conducted tour of Gump's, San Francisco's world famous art and antique shop.

Monday evening they and the delegates were guests of the California Division of Highways at the Ice Follies of 1951.

Tuesday morning the ladies were taken on a cruise of San Francisco Bay, landing in Oakland at 12 noon, proceeding by busses through Oakland and Berkeley to the Claremont Hotel where a luncheon was served. Before returning to San Francisco over the San Francisco-Oakland Bay Bridge, they were shown through the University of California campus. They were honored guests at the annual dinner in the Fairmont Hotel Tuesday night.

Wednesday morning the ladies were taken on another bus trip to Palo Alto via the Marina and Cliff House and through Hillsborough. After luncheon at Rickey's, they returned to San Francisco, by way of the Skyline Boulevard, through Stanford University, the Lake Merced area, Sunset Boulevard, and Golden Gate Park.

which may elapse between the specified date and the actual date of completion. This is not a severe deduction considering the fact that it is the same regardless of the size of project, and it is not sufficiently heavy to reimburse all engineering costs in some cases. It does, however, have a salutory effect.

"The more I delved into this subject of overruns in preparation of this discussion, the more impressed I became with the method of fixing time limits by a stated number of 'workable' days. It would seem to eliminate much of the speculation on the part of the contractor and may be more definite for both parties to the contract. Where used, it should be required that the contractor and the engineer shall each endorse a signed statement at the end of each week to indicate the number of days or fractional parts that were sufficiently workable to permit substantial progress of the work.

"Having been a part of a contracting organization that meticulously tried to meet its obligations, I can say from experience that there is scarcely nothing more discouraging in legitimate bidding than to be underbid by a contractor who has no intention of keeping his commitments and who proposes to rely upon good luck, sympathy and fictitious excuses to dissipate the penalties he knows he will deserve. If for no other reason than to encourage those who conscientiously endeavor to finish on time, we ought to enforce the penalties and liquidated damages with these derelicts. By their greed they deprive others of work and they cause the public much loss not reflected in the lower bid.

Courts Considerate

"In general, the courts are inclined to be very considerate of the rights of the contractor, and they consider along with the tightly worded contract intended to surrender his rights to the wisdom or whim of the engineer, all elements that contribute to nonperformance—and this is particularly evident in the court decisions where the owner himself has in the least degree contributed to the delays by negligence or other retardent action. The courts will sustain a reasonable amount of penalty or liquidated damages if the circumstances are due entirely to negligence or conditions which, with reasonable precaution, the contractor could have prevented.

Violations Not as Numerous

"While the matter of overruns will continue to be serious in instances—it will never be perfect—the violations are not as numerous as they were in the old days when contractor management possessed abundant zeal but operated under handicaps of primitive equipment that required more workmen, and when the management lacked much of engineering know-how. Today the conditions are much different because of great advances in the technique and capacities of construction equipment, better labor relations, and not the least of all because the educational background of contractor and engineer is now more nearly common.

"If we shall further reduce the violations of time limitations we will need to change our policy from one of considerable tolerance to one of more strict enforcement, shorn of the sympathetic and conjectural elements that are invariably interjected as reasons for time extensions. We must start the process at the level of the resident engineer for it is from him that we ought to rely for facts upon which to grant or deny extensions. It is axiomatic that the young engineer is more inclined to strict observance of the written contract than the older engineer whose experience, acquaintance and age tend to mellow his determinations.

Duty of District Engineer

"Since we have both types of engineer, one may be too severe and the other perhaps too far on the lenient side, it is incumbent upon the district engineer to know his projects so well himself that he can from actual contact in the field, and not so much from perusal of formal reports reaching his office, impartially weigh the facts and make recommendations in accordance. The district engineer, if he will, can exert more influence with the contractor in stepping up his progress than can the resident engineer, and do it probably with less unpleasantness. When we boil it down, the responsibility for bettering conditions must rest with the district engineer because it is within his province to control the field engineers, and his is the responsibility also to foresee changes and revisions so well in advance of the construction that the contractor will not be delayed or injured thereby. Let us not forget our own responsibilities in this and any other matters that contribute to overruns.

"There appears no sure panacea for the problem of time overruns, no infallible rule for inflicting penalties or liquidated damages, but we can, through recognition of our own related responsibilities and the cooperation of the construction industry, operate to reduce the extent and frequency of these unpleasant but necessary administrations of contract authority."

Bergman Retires

Continued from page 21 . . .

17 Years in San Bernardino

For 17 years Bergman worked in District VIII (San Bernardino) as chief draftsman and office engineer. From 1942 to 1946 he was assistant to the district maintenance engineer in District XI in San Diego. From 1946 to 1949 he was chief draftsman and locating engineer in District IX in Bishop until his health enforced a slowdown in his activities. In May, 1949, Bergman was transferred to the Headquarters Office in Sacramento where he worked until his retirement.

"Bergie's" many friends in the Division of Highways sincerely regret that it has been necessary for him to retire, as engineers of his ability, resourcefulness, and loyalty are most difficult to replace. They are thankful, however, that present day retirement makes it possible for Bergman, who has given the best years of his productive life for the benefit of the State, to retire with a sense of security and comfort.

Bergman is married and he and his wife have two sons and a daughter, all of whom are married with families of their own, the Bergmans having two grandchildren. The sons are both employed in the Right of Way Department of the Division of Highways, Reynard in District VI and Robert in District IV. The Bergmans are residing in San Diego.

Newly elected WASHO officers. LEFT TO RIGHT—Executive Committeeman Ralph Jones, Highway Commissioner, New Mexico; Secretary-Treasurer, Glenn S. Paxson, Bridge Engineer, Oregon; President, W. A. Bugge, State Highway Engineer, Washington; Vice President, Mark O. Watrous, State Highway Engineer, Colorado. State Highway Engineers Geo. T. McCoy, California, and J. R. Bromley, Wyoming, are the other two members of the Executive Committee.

WASHO

Continued from page 35 . . .

Wednesday morning the delegates were taken on a bus trip to view the Bayshore Freeway in San Francisco and San Mateo Counties, and the Eastshore Freeway in Alameda County. They were guests of the Oakland Chamber of Commerce at a luncheon in Tilden Park in Oakland and returned to San Francisco in the afternoon.

Thursday morning's session was devoted to reports of committees, the report of Secretary-Treasurer J. A. Elliott, Bureau of Public Roads, Fort Worth, Texas, and the election of officers. The convention adjourned at noon.

State Fair

Continued from page 28 . . .

ramento, is, of course, a continuing process. At the present time major construction is in progress on U. S. 50 in Alameda County under two contracts for four-lane divided highway between Dublin and 1½ miles west of Livermore, a total of 10.3 miles in the Livermore Valley, which will cost over $2,500,000. This improvement will connect with similar divided highway development completed more than a year ago.

Visitors to the fair from Southern California who have not traveled either the Valley Route or the Coast Route for a year or two will be impressed with the progress made in four-lane divided construction on both of these arterials connecting the northern and southern portions of the State. Under present state highway construction programs each year sees several new sections built to four-lane divided or freeway standards added to the routes. This modern development is advancing with such constancy that motorists may now look forward to the time when the State's main north-south arteries are complete four-or-more-lane thoroughfares between Los Angeles and Sacramento and Los Angeles and San Francisco.

Besides being the medium over which scores of thousands of motorists travel to the Fair, these highways are used by the huge fleet of trucks required to transport the countless tonnage which goes into the production of the multimillion dollar exposition.

Part of the tonnage this year, which ranges from livestock to orchids, will be a huge statue carved from a giant redwood felled near Three Rivers, California. The statue, fashioned by Carroll Barnes, noted sculptor, is symbolical of youth, the theme of the 1951 Fair, It will be trucked to the Fairgrounds and unveiled as a highlight of the opening day ceremony.

Heavy Truck Traffic

Simultaneously, other trucks will be on the highways converging on Sacramento with cargoes of fruit, wine, processed foods, minerals, lumber, livestock feed, farm and industrial machinery and hundreds of thousands of other items which are fractional parts of the whole which is assembled, finally, into a great fair.

Rolling toward Sacramento, too, will be scores of trailers carrying horses for the horse show and the races, while still others will be transporting speedboats for the aquatic events on September 2d and 9th.

A goodly percentage of the hundreds of thousands who enjoy the Fair also motor to Sacramento over a network of smooth highways, a startling contrast to the rough and rutted roads over which fairgoers bumped their way to California's first state fair at San Francisco in 1854.

Like the highways, the Fair, from its sketchy beginning, has developed tremendously. And the 1951 exposition promises to be the greatest of all.

Many Features

Bustling night activities will be ushered in by a magnificent display of fireworks. One of these is the sparkling Pageant of California Fashions where svelte models will display the latest creations of the State's apparel industry.

Another comprehensive art show will be presented by the Fair. The work of California artists, for which $15,000 in prizes are being offered, will be on display in the picturesque outdoor gallery opposite Governor's Hall.

In Governor's Hall, visitors will find

. . . Continued on page 57

Annual Meeting

District Right of Way Agents Report on Big Job Well Done

By GLENN L. WHITT, Headquarters Right of Way Agent

Culminating the most successful year in the history of the Right of Way Department, California's district right of way agents, and their assistants, assembled in the State Highway Commission board room in Sacramento on July 12th and 13th for their annual conference. This assembly is a yearly occasion, held under the supervision of the Chief Right of Way Agent, for the purpose of clarifying procedural details and establishing a uniform policy for the coming year.

Most Successful Year

The fiscal year just ended marked the successful completion of the largest right of way program ever attempted by any state in any one year. Approximately $40,000,000 worth of real property transactions were handled, including nearly $37,000,000 in the right of way program of the Division of Highways and approximately $3,000,000 in acquisition for other state agencies under the program instituted by the State Public Works Board through the Department of Finance.

The conference was honored this year, for the first time, by the presence at the opening session of California's Director of Public Works, C. H. Purcell, Deputy Director Frank B. Durkee, State Highway Engineer G. T. McCoy, Deputy State Highway Engineer R. M. Gillis; J. W. Vickrey, Assistant State Highway Engineer—Planning; R. H. Wilson, Assistant State Highway Engineer – Administration; Earl Withycombe, Assistant State Highway Engineer—Operations; G. F. Hellesoe, State Maintenance Engineer; Don Evans, State Construction Engineer; H. C. McCarty, Office Engineer; J. P. Murphy, Personnel and Public Relations; E. R. Higgins, Comptroller; and R. C. Kennedy, Secretary of the State Highway Commission.

Oregon Sends Representatives

Also attending, for the first time, was a delegation from the Right of Way Department of a sister state—Oregon—in the persons of R. L. Porter, Assistant State Right of Way Engineer, and Harry G. Benson, Right of Way Supervisor, Division II.

Following introductions of those in attendance and election of officers for the coming session, Chairman Frank C. Balfour, Chief Right of Way Agent, expressed to the group his personal appreciation for the wholehearted cooperation and the fine work that was accomplished during the past fiscal year.

Educational Program

Turning to the business at hand, the first item on the agenda, and the most important, was a report by E. F. Wagner, Deputy Chief Right of Way Agent and Chairman of the Education Committee, on courses to be given during the coming year under the perpetual in-training educational program. These courses are as follows: October 1st to December 17th—course on the Right of Way Manual, procedure and technique of right of way work; January 7th to February 13th—Basic Engi-

Heads of Right of Way Department and District Right of Way agents. LEFT TO RIGHT—BOTTOM ROW: Fred Moore, San Luis Obispo; John Daniels, San Francisco; G. Mulcahy, Marysville; C. G. Piper, Redding; R. H. Ramsey, Eureka. CENTER ROW: Earl Bunker, Fresno; H. Leonard, Los Angeles; Ray O'Bier, San Bernardino; Serge Roy, Bishop; Wayne Hubbard, Stockton; John C. Webb, San Diego. TOP ROW: E. F. Wagner, Los Angeles, Deputy Chief; R. S. J. Pianezzi, Sacramento, E. M. MacDonald, Sacramento, and George Pingry, San Francisco, Assistant Chiefs; Frank C. Balfour, Sacramento, Chief Right of Way Agent.

neering Course; February 18th to March 18th—general course on appraisals, negotiarion, and economic studies.

These courses are designed to initiate more audience participation, more practical work, and less self-study, with the emphasis on practical work.

The second item on the agenda was a discussion on economic studies, led by Rudolph Hess, Headquarters Right of Way Agent. Such studies, for the purpose of determining the actual effect on the market value of properties on which rights of ingress and egress have previously been restricted, are presently underway in each district. The information obtained, based on actual "before" and "after" sales, is to be distributed to all districts for use by the appraisal sections. Continuous studies are to become a permanent part of the appraisal procedure.

Economic Studies

The effect of information developed from economic studies on the planning for highway realignment or re-routing was also pointed out; particularly the data which has previously been developed on by-passed communities.

Throughout the conference assistance and advice on legal problems were received from attorneys of the Division of Contracts and Rights of Way, whose annual conference coincides with that of the Right of Way Department. Attorney Russell Monroe of the Headquarters staff, presented a summary of new legislation passed by the current session of the State Legislature affecting the Department of Public Works and the Division of Highways; Attorney Herbert Williams of the Los Angeles staff, led a discussion on recent court cases; Attorney Paul Porterfield of the San Francisco staff, led a discussion on the so-called "Integrated plant" theory; and Attorney Norris Burke presented a comprehensive analysis of the present problems involved in rearranging utilities in the way of highway construction.

On Thursday evening the entire group gathered in the Venetian Room of the Sacramento Hotel for the annual dinner. Problems and discussions begun during the day were continued with vigor during the evening.

HELPFUL TO SCHOOL

PESCADERO UNION HIGH SCHOOL
Pescadero, California

California Highways and Public Works
Sacramento, California

For a number of years you have been sending us copies of each issue of your official magazine, which we have used in connection with a number of our courses of study with what we believe have been highly satisfactory results. It is an extraordinarily informative publication of a very practical nature. It gives a comprehensive and quite inspiring account of the State's road and bridge systems; and we should like to thank you for supplying us with copies during these past years.

I should also like to add by profound gratitude for the great courtesy displayed by your department to us.

Very sincerely yours,
EDWIN F. WILLIMAN
Principal

Discussion of Appraisals

The conference reconvened promptly at 8 a.m., Friday, July 13th, with the first order of business a discussion on appraisals led by E. M. MacDonald, Assistant Chief Right of Way Agent. Mr. MacDonald's discussion clarified several of the technical details involved in the preparation of appraisals and ended with the request that the Income Capitalization method of estimating market value be used only when other, and surer, methods cannot be used.

There followed, in succession, a discussion on estimating salvage value and costs of moving improvements conducted by J. T. Zeeman, Headquarters Right of Way Agent; a discussion on certification of right of way for construction and awards of contracts, by W. M. Douglass, Headquarters Right of Way Agent; and a general discussion on real property versus personal property led by Robert E. Reed, Chief, Division of Contracts and Rights of Way.

Budget Problems

The afternoon session was thrown open to round table discussion wherein specific problems encountered by the various districts were presented for solution. More time was allotted to this portion of the conference than previously due to the fact that discussions of this nature have proven to be of great value in the past.

During the discussion, E. R. Higgins, Comptroller of the Division of Highways, became the target of a rapid-fire series of questions regarding budget problems during the past year and plans for the coming year. Mr. Higgins' assistance was invaluable and was greatly appreciated. Questions were also proposed by the Oregon delegation as to problems encountered in dealing with the Federal Bureau of Land Management and as to the sources of information for Economic Studies.

Good Will Ambassadors

The final session of the conference was, as usual, difficult to terminate. However, the curtain was drawn at 4.30 p.m. by Chairman Balfour with a reminder that Right of Way Agents are the field ambassadors of the Division of Highways and must continue to merit the confidence of the public by honest and fair dealing, under the code of ethics. He expressed pride due to the good public relations work being done and again expressed appreciation for the fine job accomplished during the past year.

Throughout the conference the value, to any organization, of a periodic meeting such as this was well demonstrated. Many administrative and procedural defects naturally appear which are difficult to correct by correspondence alone, particularly in the Right of Way Department with its district offices located in widely separated areas throughout the State. Many of such imperfections are easily and quickly corrected by the annual conference.

The Right of Way Department looks forward with confidence toward another large program for the coming year. Approximately $35,000,000 is budgeted this year for purchase of rights of way in the campaign to create for California the finest highway system in the Nation.

Temecula Study

Continued from page 8 . . .

Probably the most help to the town are the three community map-type signs placed at strategic locations along the new freeway. As can be seen from the accompanying photos, these map-signs warn the motorist as far ahead as one mile before he reaches an approach to the town. They show him briefly and simply in the form of a picture how to reach and to leave the town. By illustrating the fact that the traveler does not have to backtrack to leave town, the signs achieve a special effectiveness.

The three map-signs are a community project bought from funds contributed by every businessman in Temecula. Everyone in town considers the signs well worth their cost. In fact, the only objection seems to be that they should be larger. One enthusiastic townsman has even advocated three large billboard-size neon signs to run 24 hours a day, flashing the same map off and on.

Safety

Undoubtedly, of the greatest immediate benefit to Temecula, or any by-passed town for that matter, is the safety achieved by removing the speeding traffic from the main thoroughfare. Every resident is grateful for the diminished danger, regardless of what the economic effect upon the town may be.

Real Estate

The freeway has apparently had no adverse effects upon property values. There have been only two real estate transactions on the superseded section since the by-pass; neither indicates any loss in property values. Also, the town's only active real estate broker is of the opinion that the by-pass has had no ill effects on land values in Temecula.

CONCLUSIONS

The conclusions reached in this study are essentially the same as those reached by the merchants of Temecula. A by-pass, even of a small highway community, does not mean the death of that community. On the contrary, certain types of businesses, such as motels, may be greatly benefited by having speeding and noisy traffic removed from their front doorsteps.

Formerly a saloon, the above building was once the mecca for thirsty cowhands who brought great droves of cattle to Temecula in the 1880's and 1890's

State Fair

Continued from page 54 . . .

the amazing exhibit of the Pacific Telephone and Telegraph Company, titled "Looking Ahead With the Bell System."

As in former years, the Fair will hold its gorgeous flower show in the magnificent Hall of Flowers, a place of concentrated floral beauty and fragrance.

In other great exhibit palaces will be an array of displays that are almost endless. One of the most timely will be that of the California Office of Civil Defense. It will stress protective measures in the event of an atomic attack.

Other exhibits will feature machinery, foods, hobbies, home appliances, furniture, tools and, in fact, almost everything pertinent to the American way of life.

Among the many displays in the Educational Exhibits area will be those of the State Department of Natural Resources, the State Division of Industrial Relations, the Social Security Administration and the armed services.

One of the new attractions—the Junior California Museum—will be housed in the nearby Regional Building. Here, visitors will find a wealth of exhibits, devoted mostly to the natural history of California.

There will be free entertainment attractions galore—music by dozens of bands, precision stepping by drill teams, antics of strolling clowns, dancing, vaudeville shows and scores of special events. Two outstanding soloists will appear twice daily with the California State Fair Band. They are Raphael Mendez, one of the world's foremost trumpet players, and Patricia Lynn, featured singer in many big musical productions.

There will be the major livestock shows, with thousands of purebreds competing for $76,152 in the open division and $31,000 in the junior division, the latter split between Future Farmers of America and 4-H Clubs. In kindred fields, exhibitors will vie for $2,750 for dairy products and $5,500 for poultry, pigeons and rabbits.

Other facets of rural life will be shown in the imposing Agriculture Building, teeming with fruit, grain, vegetables and other products of the farm, all displayed against colorful backgrounds of the various county exhibits. More than 35 counties will present ingenious displays this year. In addition, the Agriculture Building will house the exhibits of many foreign nations and the Wine Institute's garden which this year will feature wine tastings of the State's vintages. This year, too, the vintners of the State will com-

. . . Continued on page 58

Another view of new Alpine Road in San Mateo County looking west

Alpine Road

Continued from page 10 . . .

the heavy, early winter made a shutdown necessary. After the winter the contractor had to scarify and relay his crusher run base, as well as take care of other winter damage.

Preliminary and construction engineering was performed under the direction of M. A. Grant, County Engineer and Road Commissioner, subject to the approval of the Division of Highways. The wholehearted cooperation received by the county engineer and his staff from the State Division of Highways' personnel has been greatly appreciated. This cooperation facilitated the planning and construction of this project, and we look forward to future F. A. S. projects. The design work is now under way for certain of the F. A. S. routes in San Mateo County.

Rights of way were acquired by the County of San Mateo. Court action was not necessary, except a friendly condemnation suit was required against the Leland Stanford Junior University. Construction was performed under contract by Eugene G. Alves, general contractor of Pittsburg, California, at a cost of approximately $142,500.

State Fair

Continued from page 57 . . .

pete for gold medals and blue ribbons at the Fair's wine show.

Stellar Horse Show

Among the many outstanding attractions will be the fashionable horse show, with nearly 450 horses going through their paces for premiums amounting to more than $35,000. This stellar event will be held each evening, with jumping and other outdoor events in the afternoons, except on September 2d and 9th.

On these two days speedboat racing will be featured. Fast outboards will rocket over the Fair's racing moat on September 2d and the following Sunday the inboards, even faster, will roar over the aquatic course.

The Fair will stage a splendid horse race meet on week days during the Fair. Ten events are scheduled for each day, climaxed by the Governor's Handicap, $10,000 added, on September 6th. Purses for the meet total more than $125,000.

Outstanding Stars

The night theatrical spectacles will be more spectacular and entertaining than ever. Presented on the miracle stage in front of the grandstand, the night shows will feature such outstanding stars as Dennis Day, Jerry Colonna, the Sons of Pioneers, Harry "Woo-Woo" Stevens, the Will Mastin Trio, Jack Cathcart's Continentals and many other acts, including a three-ring circus.

All Fair attractions, with few exceptions, are free to those who have paid the low admission price of 50 cents to the grounds. Children under 12 are admitted free.

General admission to the horse races is $1; reserved seats $1.50 and boxes $2.40. The charge for children under 12 is 50 cents and they must be accompanied by an adult.

General admission to the night show is 60 cents; reserved seats $1.20 and boxes $1.80. Children under 12 are admitted free to the unreserved section but must be accompanied by an adult.

General admission to the horse show is 60 cents; reserved seats $1.20 and boxes $1.80. Children under 12, when accompanied by an adult, are admitted free.

HIGHWAY BIDS AND AWARDS

June, 1951

BUTTE COUNTY—Between Biggs Road and Oroville Wye, about 5.4 miles, constructing plant mixed surfacing on untreated rock base over existing pavement and borders on a portion of the project and constructing plant mixed surfacing on existing pavement and borders on the remainder of the project, applying a seal coat to plant mixed surfacing and applying penetration treatment to the shoulders. District III, Route 3, Section B. P. J. Moore & Son and Floyd O. Bailey, Tracy, $164,447. Contract awarded to Rice Bros. Inc., Marysville, $160,881.50.

EL DORADO COUNTY—Across Trout Creek and Upper Truckee River, about three miles west of Bijou, existing bridges to be repaired and detours to be graded, surfaced with lime treated imported subbase material and liquid asphalt penetration treatment and detours to be removed. District III, Route 11, Section K. J. Henry Harris, Berkeley, $69,018; Joe Chevreaux & Ted Schwartz, Grass Valley, $49,870. Contract awarded to H. W. Ruby, Sacramento, $43,544.80.

EL DORADO AND AMADOR COUNTIES—At Cosumnes River, about 4.8 miles north of Plymouth, a reinforced concrete box girder bridge to be constructed and approaches about 0.4 mile in length to be graded and surfaced with imported surfacing material on imported base material and bituminous surface treatment and seal coats applied. District X, Route 65, Sections A,C. LeFever & Bing, Sacramento, $199,834; G. M. Carr & Bati Rocca, Santa Rosa, $221,409; Pike & Hill, Carey Bros. Construction Co. & Bailey Construction Co., San Rafael, $216,645; Charles MacClosky Co., San Francisco, $263,593. Contract awarded to Thomas Construction Co., Fresno, $191,927.40.

EL DORADO COUNTY—At various locations between 2.4 miles west of Riverton and Strawberry, mineral aggregates and screenings to be furnished and stockpiled. District III, Route 11, Sections F,G,H,I. Contract awarded to Liston Ehorn, Red Bluff, $36,365.

EL DORADO COUNTY—At Echo Creek, about 0.3 mile south of junction of Route 11, a reinforced concrete bridge to be constructed and about 0.3 mile of approaches to be graded and bituminous surface treatment applied. District X, Route 23, Section A. Joe Chevreaux & Ted Schwartz, Grass Valley, $46,249. J. Henry Harris, Berkeley, $61,423; B. S. McElderry, Berkeley, $70,289. Contract awarded to H. W. Ruby, Sacramento, $43,475.50.

EL DORADO COUNTY—In the City of Placerville at the intersection of Coloma, Spring and Mill Streets, for widening with plant-mixed surfacing on untreated rock base and constructing a retaining wall, curbs, gutters and sidewalks. District III, Route 65. Brighton Sand & Gravel Co., Sacramento, $6,407. Contract awarded to Joe Chevreaux, Auburn, $4,120.

GLENN COUNTY—Between 1.1 miles south of Walker Creek and Walker Creek, about 1.1 miles to be graded and surfaced with plant mixed surfacing on cement treated crusher run base. District III, Route 7, Section B. Clements & Co., Hayward, $152,918. Contract awarded to C. V. Kenworthy, Stockton, $139,687.

HUMBOLDT COUNTY—Install truck scales and construct approaches about seven miles north of Arcata and at junction of Route 20 and Korbel Road. District I, Routes 1, 20, Sections I,AB. Humboldt Constructors, Inc., Eureka, $53,185. Contract awarded to Mercer, Fraser Co., & Mercer, Fraser Gas Co. Inc., Eureka, $42,753.19.

HUMBOLDT COUNTY—Over Burns Freeway, at 11th & 14th Streets in Arcata, two reinforced concrete girder bridges to be constructed and approaches to be graded and surfaced with plant mixed surfacing on imported base material. District I, Route 1. Erickson, Phillips and Weisberg, Oakland, $291,840; G. M. Carr & Bati Rocca, Santa Rosa, $297,988. Contract awarded to Mercer, Fraser Co. & Mercer Fraser Gas Co. Inc., Eureka, $279,958.90.

HUMBOLDT COUNTY—At North Fork Mad River, about 7.5 miles east of Blue Lake, a structural steel and reinforced concrete bridge to be constructed and about one half mile of approaches to be graded and surfaced with plant mixed surfacing on cement treated base. District I, Route 20, Section B. Mercer, Fraser Co. & Mercer Fraser Gas Co. Inc., Eureka, $382,587. Contract awarded to G. M. Carr, Bati Rocca and John Burman & Sons, Eureka, $367,195.60.

HUMBOLDT COUNTY—Across Grizzley Creek, about 7.2 miles west of Bridgeville, an existing reinforced concrete birder bridge to be repaired. District I, Route 35, Section B. Frederickson Bros., Emeryville, $23,570. Humboldt Constructors, Inc., Eureka, $27,162; Mercer Fraser Co. & Mercer Fraser Gas Co. Inc., Eureka, $28,979. Contract awarded to G. M. Carr & Bati Rocca, Santa Rosa, $22,033.50.

KERN COUNTY—Between south boundary of Sequoia National Forest and 2.5 miles southwest of Democrat Springs, about 5.3 miles damaged portions of roadbed to be graded and bituminous surface treatment applied. District VI, Route 57, Sections F,G. Dicco, Inc., Bakersfield, $176,926; Oilfields Trucking Co. & Phoenix Construction Co. Inc., Bakersfield, $182,648. Contract awarded to Norman I. Fadel, North Hollywood, $119,222.

LAKE COUNTY—Across Seigler Creek and Cache Creek, respectively, just west of the west city limit and 1.2 miles north of the north city limit of Lower Lake, two reinforced concrete bridges to be constructed and approaches to one bridge to be graded. District I, Route 49, Section C. Lew Jones Construction Co., San Jose, $159,544; Chittenden & Chittenden & R. S. McElderry, Auburn, $163,832; Erickson, Phillips & Weisberg, Oakland, $180,399. Contract awarded to Tumblin Co., Bakersfield, $144,332.

LOS ANGELES COUNTY—In the City of Los Angeles on Harbor Freeway between Temple Street and Third Street, in the Four-Level area, and on Hollywood-Santa Ana Freeway between Grand Avenue and Los Angeles Street, highway lighting and illuminated sign systems to be furnished and installed. District VII, Routes 2,165. Fischbach & Moore, Inc., Los Angeles, $106,336. Contract awarded to Ets-Hokin & Galvan, Inc., Wilmington, $105,633.

LOS ANGELES COUNTY—On Ramona Freeway from Helen Drive to Eighth Street, highway lighting and illuminated sign systems to be furnished and installed. District VII, Route 26, Sections D,L,A,Alh. Fischbach & Moore, Inc., Los Angeles, $88,763; Ets-Hokin & Galvan, Inc., Wilmington, $88,920; Westates Electrical Construction Co., Los Angeles, $91,368. Contract awarded to Electric & Machinery Service, Inc., South Gate, $87,123.

LOS ANGELES COUNTY—On Ramona Freeway in Alhambra between Hellman Avenue and Eighth Street, about 0.9 mile to be graded and paved with Portland cement concrete on cement treated subgrade and with plant-mixed surfacing on imported base material; and three bridges to be constructed; to provide a six-lane divided highway with frontage roads. District VII, Route 26. Bongiovanni Construction Co., Los Angeles, $1,312,704; J. E. Haddock, Ltd., Pasadena, $1,340,733. Contract awarded to Griffith Co., Los Angeles, $1,303,598.85.

LOS ANGELES COUNTY—In the City of Long Beach on Los Angeles River Freeway, from State Street to 223d Street, highway lighting and illuminated sign systems to be furnished and installed. District VII, Route 167. Electric & Machinery Service, Inc., South Gate, $68,640; Westates Electrical Construction Co., Los Angeles, $69,488; Ets-Hokin & Galvan, Inc., Wilmington, $70,123. Contract awarded to Fischbach & Moore, Inc., Los Angeles, $68,212.

MARIPOSA COUNTY—Between Briceburg and Yosemite National Park Boundary, about 17.7 miles grouted rock toe walls and riprap to be constructed, portions to be graded and plant-mixed surfacing to be placed over existing surface and untreated rock base. District X, Route 18, Sections E,F,G,H. Eaton & Smith, San Francisco, $1,229,085; United Concrete Pipe Corp., Baldwin Park, $1,288,288. Contract awarded to Piombo Construction Co., San Francisco, $1,212,424.50.

MERCED COUNTY—Furnishing and installing traffic signal system and highway lighting in the City of Merced at the intersection of 16th Street with G Street. District X, Route 4. R. Goold & Son, Stockton, $7,269. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $6,941.

SAN DIEGO COUNTY—Between 0.7 mile south of San Marcos Creek and 2.2 miles south of Carlsbad, about 3.2 miles, construction of a graded roadbed adjacent to the existing highway and Portland cement concrete pavement on cement treated subgrade, surfacing the existing pavement with plant mixed surfacing and applying seal coats thereto; and construction of three reinforced concrete bridges and one double reinforced concrete box culvert. District XI, Route 2, Section B. Griffith Co., Los Angeles, $641,997. Contract awarded to Cox Bros. Construction Co., Stanton, $637,345.

SAN DIEGO COUNTY—On Pacific Highway between E Street and Date Street, in the City of San Diego, two traffic signal systems and lighting systems to be reconstructed: Portland cement concrete curbs to be removed and reconstructed and plant mixed surfacing and seal coats to be constructed. District XI, Route 2. Westates Electrical Construction Co., Los Angeles, $38,102; California Electric Works, San Diego, $38,405. Contract awarded to Ets-Hokin & Galvan, San Diego, $36,824.30.

SOLANO COUNTY—Furnishing and installing traffic signal system and highway lighting at intersection of Sonoma Street with Nebraska Street. District X, Route 74, Section A. Ed Pierce Electric Co., Inc., Vallejo, $6,234. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $5,849.

SONOMA COUNTY—Furnish and install highway lighting and modify existing traffic signal systems on Santa Rosa Freeway, between Steele Lane and Barham Avenue. District IV, Route 1, Sections E,Sro. L. H. Leonardi Electric Construction Co., San Rafael, $15,979; R. Flatland, San Francisco, $16,286; Hall Sloat Electric Co. Inc., Oakland, $16,592. Contract awarded to Karl F. Stolting, Santa Rosa, $14,425.

TULARE COUNTY—Across Deep Creek about 5.4 miles east of Visalia, a reinforced concrete slab bridge to be constructed and a detour to be graded and surfaced. District VI, Route 10, Section C. Thomas Construction Co., Fresno, $47,785. Contract awarded to Rex B. Sawyer, Visalia, $43,676.

LOS ANGELES COUNTY—Over Los Angeles River and Southern Pacific Co. tracks at Figueroa Street and over Southero Pacific Co. tracks at Alhambra Avenue, existing steel bridges to be cleaned and painted. District VII, Routes 165,4. Acme Maintenance & Engineering Co., Montebello, $30,082; Timmons Painting and Engineering Co., Long Beach, $44,748. Contract awarded to G. C. Hewitt & Co. Ltd., Los Angeles, $25,945.

LOS ANGELES COUNTY—On Harbor Freeway between Fourth Street and Temple Street, about 0.6 mile to be graded and paved with Portland cement concrete and asphalt concrete. District VII, Route 165. Griffith Co., Los Angeles, $714,039. Contract awarded to Webb & White, Los Angeles, $669,922.

LOS ANGELES COUNTY—On Lincoln Boulevard, between the south city limits of Los Angeles and Washington Boulevard, about 0.3 mile roadway to be excavated, untreated rock base to be constructed and surfaced with plant mixed surfacing. District VII, Route 60. Vernon Paving Co., Los Angeles, $15,030; Jesse S. Smith, Glendale, $15,796; George Savala, Studio City, $16,547; Griffith Co., Los Angeles, $17,976; McClain Construction Co. Inc., Hawthorne, $19,301. Contract awarded to Oswald Bros. Co., Los Angeles, $14,500.

LOS ANGELES COUNTY—On Murphy Street between Eastern Avenue and connection with the Ramona Freeway, about one half mile to be graded and surfaced with plant mixed surfacing on imported base material and a steel beam span bridge for the Pacific Electric Railway to be constructed. District VII, Route 26, Section D,LA. Charles MacClosky Co., San Francisco, $187,660; Griffith Co., Los Angeles, $196,634; Hickinger & Welker, Los Angeles, $220,273; Norman I. Fadel, North Hollywood, $223,407. Contract awarded to J. E. Haddock, Ltd., Pasadena, $154,174.70.

LOS ANGELES COUNTY—On Hollywood Freeway, in the City of Los Angeles, between Cahuenga Boulevard and Gower Street, five bridges to be constructed and about 0.6 mile to be graded and surfaced with Portland cement concrete pavement on imported base material. District VII, Route 2. Webb & White & George W. Peterson & Jack W. Baker, Los Angeles, $1,659,680; Charles MacClosky Co., San Francisco, $1,693,865; Bongiovanni Construction Co., Hollywood, $1,794,655; Griffith Co., Los Angeles, $1,892,442; Guy F. Atkinson Co., Long Beach, $1,907,586; Peter Kiewitt Sons' Co., Arcadia, $1,992,576; J. E. Haddock Ltd., Pasadena, $2,024,017. Contract awarded to Winston Bros. Co., Monrovia, $1,634,442.95.

LOS ANGELES COUNTY—Between Route 60 and 223d Street in the City of Long Beach, about 2.5 miles to be graded and paved with Portland cement concrete, interchange roads and acceleration and deceleration lanes to be surfaced with plant-mixed surfacing on untreated rock base and a grade separation structure to be constructed to provide a freeway with a six-lane divided roadway. District VII, Route 167. Guy F. Atkinson Co., Long Beach, $1,434,996; Basich Bros. Construction Co., N. L. Basich and R. L. Basich, Garvey, $1,551,103; J. E. Haddock, Ltd., Pasadena, $1,590,958. Contract awarded to Griffith Co., Los Angeles, $1,429,146.

LOS ANGELES COUNTY—On Hollywood Freeway, at Bronson Avenue and Gower Street, in the City of Los Angeles, two reinforced concrete bridges and storm drain and sanitary sewer systems to be constructed. District VII, Route 2. Lars Oberg & Chas. J. Rounds, Los Angeles, $927,909; Charles MacClosky Co. & Radich & Ferguson, Inc., San Francisco, $947,880; Webb & White, Los Angeles, $950,372; Winston Bros. Co., Monrovia, $981,295; Bongiovanni Construction Co., Hollywood, $982,286; MacDonald & Kruse & Pacific Allied, Sun Valley, $1,149,759. Contract awarded to George W. Peterson & Jack W. Baker, Los Angeles, $913,870.

LOS ANGELES COUNTY—In Culver City at the intersections of Sepulveda Boulevard with Sawtelle Boulevard and Jefferson Boulevard Playa Street and the intersection of Firestone Boulevard with Graham Street, semitraffic actuated signal system and highway lighting at two intersections and fixed time traffic signal system at one intersection to be furnished and installed. District VII, Routes 158,174. Sections B,CIC,B. Westates Electrical Construction Co., Los Angeles, $20,980; Electric & Machinery Service, Inc., South Gate, $21,338; Fischbach & Moore, Inc., Los Angeles, $21,761. Contract awarded to C. D. Draucker Inc., Los Angeles, $20,510.

MARIN SONOMA COUNTIES—Across Richardson Bay and the tracks of the Northwestern Pacific Railroad Company, about 1.5 miles north of Sausalito, over the tracks of the Northwestern Pacific Railroad Company at Forbes Station and across Russian River at Healdsburg, three existing steel bridges to be cleaned and painted. District IV, Route 1, Sections C,A,B. R. W. Reade & Company, Berkeley, $25,946. Contract awarded to Bill Reid Painting Service, Sacramento, $24,775.

MONO COUNTY—Between five miles north of Sonora Junction and Antelope Valley, portions, about 2.7 miles in length, to be graded and road mixed surfacing to be placed on imported base material. District IX, Route 23, Section K. Contract awarded to R. P. Shea, Co., Indio, $204,774.40.

MARIPOSA COUNTY—Between Cathay Junction and five miles east, about five miles to be surfaced with plant mixed surfacing on untreated rock base. District X, Route 18, Section I. M. J. Ruddy & Son, Modesto, $182,341. Contract awarded to Munn and Perkins, Modesto, $163,259

ORANGE COUNTY—At the intersection of Manchester Avenue with La Palma Avenue and Fullerton Road with Imperial Highway, furnish and install traffic actuated signal system and modifying highway lighting system at one intersection and furnishing and installing full traffic actuated signal system with highway lighting at one intersection. District VII, Routes 174, 2, 176, Sections A,F,A. Electric and Machinery Service, Inc., South Gate, $23,057; Fischbach and Moore, Inc., Los Angeles, $23,689; Westates Electrical Construction Co., Los Angeles, $23,760. Contract awarded to C. D. Draucker, Inc., Los Angeles, $22,641.

ORANGE COUNTY—On Santa Ana Freeway, between Broadway in Santa Ana and First Street, a railroad underpass, five highway separation structures and a pedestrian undercrossing to be constructed and about 2.8 miles to be graded and portions to be surfaced with Portland cement concrete pavement on cement treated sub base; interchange roadways, acceleration and deceleration lanes and outer highways to be surfaced with plant-mixed surfacing on untreated rock base, to provide a freeway with four-lane divided roadbed. District VII, Routes 174, 2, Sections SA,C. Griffith Co., Los Angeles, $2,460,271; Guy F. Atkinson Co., Long Beach, $2,486,505; Peter Kiewit Sons' Co., Arcadia, $2,547,789; United Concrete Pipe Corp., Baldwin Park, $2,563,215; Allison Honer Co. & Cox Bros. Construction Co., Santa Ana, $2,584,340. Contract awarded to Winston Bros. Co., Monrovia, $2,439,710.

RIVERSIDE COUNTY—Between 0.6 mile west of west junction with Route 187 and 1.2 miles east of Whitewater, about 3.9 miles to be graded and surfaced with plant mixed surfacing on cement treated base and two reinforced concrete bridges to be constructed. District VIII, Route 26, Sections C,D. Griffith Co., Los Angeles, $1,053,815; Peter Kiewit Sons' Co., Arcadia, $1,167,905; Fredericksen & Kasler, Sacramento, $1,196,017; R. R. Hensler, Sun Valley, $1,349,984. Contract awarded to Basich Bros. Construction Co., N. L. Basich & R. L. Basich, Garvey, $1,049,143.10.

RIVERSIDE COUNTY—In the City of Riverside, on Magnolia Avenue at Central Avenue—Brockton Avenue and at Jurupa Avenue, traffic signal systems to be furnished and installed and traffic island curbs and driveway to be constructed. District VIII, Route 43, Westates Electrical Construction Co., Los Angeles, $28,300; Paul R. Gardner, Ontario, $29,460. Contract awarded to Fischbach & Moore, Inc., Los Angeles, $27,612.

SACRAMENTO COUNTY—Across Cosumnes River near Bridgehouse, a bridge to be constructed and about 0.8 mile of approaches to be graded and surfaced with plant mixed surfacing. District III, Route 54, Section C. George Pollock Co., Sacramento, $191,963; Geo. M. Carr & Bati Rocca, Santa Rosa, $192,870; Lefever & Bing, Sacramento, $193,102; Thomas Construction Co., Fresno, $202,118; H. W. Ruby, Sacramento, $207,815. Contract awarded to Al Erickson & Co., Napa, $190,537.50.

SAN BERNARDINO COUNTY—In the City of Colton, between Route 26 and Grant Avenue, about 1.3 miles, existing roadbed to be widened and surfaced with plant mixed surfacing. District VIII, Route 31, Matich Bros. Paving Co., Colton, $85,782; Geo. Herz & Co., San Bernardino, $98,471; R. A. Erwin, Colton, $99,895; E. L. Yeager & Co., Riverside, $105,110. Contract warded to Hubbs Equipment Co., Colton, $84,447.50.

SAN BERNARDINO COUNTY—Across Mojave River at Victorville, and over the tracks of the Atchison, Topeka & Santa Fe Railway Co. at Barstow, and at Mt. Vernon Avenue in San Bernardino, three existing steel bridges to be cleaned and painted. District VIII, Route 31, Sections D,G,Sbd. Timmons Painting and Engineering Co., Long Beach, $33,333; Acme Maintenance Engineering Co., Montebello, $44,562; G. C. Hewitt & Co. Ltd., Los Angeles, $47,595. Contract awarded to Baker & Pollock, Ventura, $28,654.

SAN BERNARDINO, RIVERSIDE AND ORANGE COUNTIES—At various locations, about 45.2 miles in net length, a seal coat to be applied. District VIII. Covina Construction Co., Covina, $88,379; G. J. Payne Co., Los Angeles, $103,412; G. & H. Paving Co., Los Angeles, $107,505. Contract awarded to Geo. Herz & Co., San Bernardino, $77,260.60.

SAN DIEGO COUNTY—Between Balboa Avenue in the City of San Diego and Las Flores, portions, about 5.2 miles in length, to be surfaced with plant-mixed surfacing. District XI, Route 2, Section SD, A,B,Ocn,C. Cox Bros. Construction Co., Stanton, $145,787. Contract awarded to Griffith Co., Los Angeles, $103,178.

SAN DIEGO COUNTY—Between 0.13 mile south of San Luis Rey River and entrance to Camp Pendleton, the existing steel truss bridge across San Luis Rey River to be widened and the existing approaches to be widened by constructing plant-mixed surfacing on Portland cement concrete base. District XI, Route 2, Ocn,C. Allison Honer Co. & Cox Bros. Construction Co., Santa Ana, $994,560; Guy F. Atkinson Co., Long Beach, $1,017,426. Contract awarded to Charles MacClosky Co., San Francisco, $989,677.60.

SAN DIEGO COUNTY—At the intersections of Montgomery Freeway with 18th Street and with 24th Street in National City and at the intersection of Montgomery Freeway with E Street in Chula Vista, highway lighting to be furnished and installed. District XI, Route 2, NatC,ChV. Ets-Hokin & Galvan, San Diego, $3,831; Westates Electrical Construction Co., Los Angeles, $4,165. Contract awarded to California Electric Works, San Diego, $3,700.

SAN DIEGO COUNTY—At Hancha Creek, about 10 miles east of Bonsall, a reinforced concrete bridge to be constructed and about one third mile to be graded and surfaced with road mixed surfacing on selected material base. District XI, Route 195, Section B. H. R. Breeden, Compton, $43,348; E. G. Perham, Los Angeles, $44,347; Cox Bros. Construction Co., Stanton, $45,201; Norman I. Fadel, North Hollywood, $47,201. Contract awarded to Einer Bros. Inc., Escondido, $41,410.62.

SAN FRANCISCO COUNTY—Over the presidio of San Francisco in the City of San Francisco, an existing steel bridge to be cleaned and painted. District IV, Route 2. Russell Hinton Co., San Francisco, $76,678; R. W. Reade Co., Berkeley, $78,244. Contract awarded to M & K Corp., San Francisco, $30,259.

SAN FRANCISCO CITY AND COUNTY—On Bayshore Freeway between 18th Street and Bryant Street, a portion of a bridge and miscellaneous road work to be constructed. District IV, Routes 68, 2. Charles MacClosky Co. & Eaton & Smith, San Francisco, $3,235,995; Guy F. Atkinson Co., South San Francisco, $3,257,405; Frederickson & Watson Construction Co. & M & K Corp., Oakland, $3,271,073. Contract awarded to Chas. L. Harney, Inc., San Francisco, $3,044,734.50.

SAN FRANCISCO COUNTY—Across Presidio of San Francisco at the easterly end of the San Francisco approach to the Golden Gate bridge in the City of San Francisco, the existing reinforced concrete bridge to be repaired. District IV, Route 2. Healy-Tibbitts Construction Company, San Francisco, $51,285. Contract awarded to Eaton & Smith, San Francisco, $43,000.

SAN JOAQUIN COUNTY—Painting buildings at District X Office, Shop, and prefabricated buildings in Stockton. Roger W. Case, Stockton, $5,030; J. F. Ecker, Stockton, $5,656; Alman Painting and Decorating Co., Stockton, $5,986. Contract awarded to Henry Wolters & Son, Stockton, $3,803.

SAN MATEO COUNTY—Trees to be removed in the City of San Bruno between Angus Avenue West and Sylvan Avenue. District IV, Route 2. Precision Stump Extractors, San Francisco, $4,900; Modern Tree Experts, Santa Rosa, $6,950. Contract awarded to Leslie S. Mayne, San Mateo, $4,320

SANTA BARBARA COUNTY—At Gaviota Gorge, about 1.5 miles south of Las Cruces, a concrete lined tunnel to be constructed and about 0.1 mile of roadway to be graded and paved with Portland cement concrete. District V, Route 2, Section E. Macco Corp., Paramount, $798,429. Contract awarded to Rhoades Shofner Construction Co., Inc., Los Angeles, $464,929.60.

SIERRA COUNTY—At Salmon Creek, about 3.8 miles north of Sierra City, the existing reinforced concrete girder bridge to be repaired by the construction of one additional span. District III, Route 25, Section B. Ted Schwartz, Grass Valley, $27,677; Chittenden & Chittenden & B. S. McElderry, Auburn, $31,055; O'Connor Bros., Red Bluff, $33,785. Contract awarded to Lefever & Bing, Sacramento, $24,950.

SISKIYOU COUNTY—Across Thompson Creek about 12 miles northeast of Happy Camp, a bridge to be constructed and about 0.15 mile of approaches to be graded. District II, Route 46, Section B. J. P. Brennan, Redding, $41,172; B. S. McElderry, Berkeley, $55,672. Contract awarded to E. H. Peterson & Son, Richmond, $36,768.60.

SONOMA COUNTY—In the City of Healdsburg, at the intersections of West Street with North Street, and with Matheson Street, traffic signal systems to be furnished and installed. District IV, Route 1. Karl F. Stolting, Santa Rosa, $9,697; R. Flatland, San Francisco, $9,760; Howard Electric Co., Gilroy, $12,311; Abbett Electric Corp., San Francisco, $12,874. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $9,253.

SONOMA COUNTY—At Sheephouse Creek about 2.6 miles west of Duncan Mills, a reinforced concrete box culvert to be constructed and about 250 feet of roadway to be graded and bituminous surface treatment applied. District IV, Route 104, Section A. Helwig Construction Co., Sebastopol, $24,708; Charles S. Moore & Robert R. Murdoch, Oakland, $24,803; G. M. Carr & Bati Rocca, Santa Rosa, $24,978. Contract awarded to Wheeler Construction Co., Oakland, $23,529.75.

TUOLUMNE COUNTY—Between Jamestown and Sonora, about 3.3 miles to be graded and surfaced with plant-mixed surfacing on untreated base, a reinforced concrete arch culvert to be constructed and an existing bridge to be widened. District X, Route 13, Section B,Sra. Eaton & Smith, San Francisco, $680,257; Guy F. Atkinson Co., South San Francisco, $746,890; Piombo Construction Co., San Francisco, $758,563. Contract awarded to Harms Bros., Sacramento, $596,743.87.

YUBA COUNTY—Between Morrison's Crossing and Wheatland, bituminous surface treatment of existing shoulders, 2.4 miles. District III, Route 3, Section A. Browne & Krull, Hayward, $8,050; Brighton San & Gravel Co., Sacramento, $29,330. Contract awarded to Claude C. Wood Co., Lodi, $7,183.75.

F. A. S. County Routes

BUTTE COUNTY—Under the tracks of the Western Pacific Railroad Company and Southern Pacific Company and at the High Sierra Pine Mills, near the City of Oroville, two underpasses and a bridge to be constructed. District III, Route 1169. Chittenden & Chittenden and B. S. McElderry, Auburn, $243,275. Contract awarded to C. K. Moseman, Belmont, $207,312.75.

LOS ANGELES COUNTY—Across San Gabriel River, on Orangethorpe Avenue, a reinforced concrete girder bridge to be constructed. District VII, Route 737. Charles MacClosky Co., San Francisco, $209,881; E. G. Perham, Los Angeles, $216,808; C. B. Tuttle Co., Long Beach, $218,162; John Strona, Pomona, $228,872; Byerts & Sons, Los Angeles, $244,851. Contract awarded to Oberg & Cook, Gardena, $199,301.50.

SAN BENITO COUNTY—On Fairview Road between Mansfield Road and Lone Tree Road about 1.6 miles to be graded and imported base material placed and a penetration treatment applied. District V, Route 670. Volpa Bros., Fresno, $25,663; Paul E. Woof, Fresno, $27,391; H. Sykes, Patterson, $31,173; Huntington Bros., San Anselmo, $36,427. Contract awarded to Granite Construction Co., Watsonville, $23,969.

SANTA CLARA COUNTY—On McKee Road between Baysbore Highway and Gordon Avenue, about 3.1 miles in length, the existing roadbed to be widened; plant-mixed surfacing with seal coat to be placed on existing pavement and on imported base material, shoulders to be constructed of imported base material and a Class B-dbl. seal coat applied thereto; to provide a four-lane divided highway. District IV, Route 1016. A. J. Raisch Paving Co., San Jose, $248,986; Leo F. Piazza Paving Co., San Jose, $260,014. Contract awarded to Edward Keeble, San Jose, $242,779.50.

July, 1951

ALAMEDA COUNTY—Between Hopyard Road and 2.5 miles west of Dublin, about 4.6 miles in length, a new roadway parallel to the existing roadway on portions of the project and a four-lane divided highway on other portions to be graded and surfaced with P. C. C. pavement on C. T. S.; road connections and transitions to be graded and surfaced with P. M. S. on existing pavement and on various types of bases; bridges and miscellaneous drainage structures to be constructed and highway lighting facilities to be furnished and installed; to provide a four-lane divided highway for the full length of the project. Guy F. Atkinson Co., South San Francisco, $1,583,375.70; Ball & Simpson and San Ramon Valley Land Co., Berkeley, $1,576,350.26. Contract awarded to Fredrickson & Watson Construction Co., Oakland, $1,374,058.80.

CALAVERAS COUNTY—Across North Fork Calaveras River about 2½ miles north of San Andreas, a bridge to be constructed and about 0.1 mile of approaches to be graded, I. B. M. to be placed and surfaced with plant-mixed surfacing. Haas & Rothschild, San Francisco, $109,574; James H. McFarland, San Francisco, $97,437; Lafever & Bing, West Sacramento, $84,878; Elmer J. Warner, Stockton, $83,545; Chittenden & Chittenden and B. S. McElderry, Auburn, $82,941.50; Pike & Hill, Bailey Construction Co., and Carey Bros. Construction Co., San Rafael, $79,852; George Pollock Co., Sacramento, $79,424; Thomas Construction Co., Fresno, $73,810.50. Contract awarded to Charles S. Moore & Robert R. Murdoch, Oakland, $64,915.

COLUSA COUNTY—Between Arbuckle and 3 miles north, about 3 miles in length to be graded and surfaced with P. M. S. on C. R. B. and four reinforced concrete slab bridges to be constructed. District III, Route 7, Section A. Harms Bros., Sacramento, $456,108.30. Contract awarded to Clements & Co., Hayward, $378,862.10.

FRESNO AND MADERA COUNTIES—Between north of Selma and Merced County line, portions, about 13.0 miles in length, roadside areas to be prepared and planted. District VI, Route 4, Sections AC; A, C. Dana R. Tyson Co., Sacramento, $18,846.35; Stephen L. Vistica, San Mateo, $15,336.95; Olivers Flower Shop and Nursery, Fresno, $13,616.75. Contract awarded to Huettig, Schromm and Bennett, Palo Alto, $12,674.25.

INYO COUNTY—Between 11 miles north of Trona and Death Valley National Monument, about 25.7 miles in length, seal coat to be applied to portions, R.M.S. to be placed on portions, and cement treatment to be applied to other portions of the project. District IX, Route 1065. Pacific Rock & Gravel Co., Monrovia, $103,705; George Herz & Co., San Bernardino, $91,455; Dicco, Inc., Bakersfield, $87,941.25; Flickinger-Welker, Los Angeles, $83,238; Rexroth & Rexroth, Bakersfield, $73,872.50; Jesse S. Smith & Robert R. Hare, Glendale, $71,797.50. Contract awarded to Verne MacArthur, La Crescenta, $68,611.25.

KERN COUNTY—Between 1.7 miles and 7.2 miles north of Randsburg Junction, about 4.9 miles in net length to be graded. Imported borrow to be placed and surfaced with R. M. S. District IX, Route 145, Section A. R. P. Shea Co., Indio, $115,000; Geo. Hertz & Co., San Bernardino, $99,920.30; Dicco, Inc., Bakersfield, $94,554.75; C. W. Peterson, North Hollywood, $89,915; Flickinger-Welker, Los Angeles, $85,520; Rexroth & Rexroth, Bakersfield, $79,528; Lowe & Watson, San Bernardino, $76,472.75; Jesse S. Smith & Robert R. Hare, Glendale, $73,971.50. Contract awarded to E. C. Young, San Fernando, $73,295.50.

KERN COUNTY—Between 4.5 miles northwest of Isabella and Isabella Dam Site, about 4.6 miles in length to be graded and surfaced with I. B. M. with the upper portion B. S. T. and a reinforced concrete and structural steel bridge to be constructed. District VI, Route 142, Section F. Ball & Simpson, Berkeley, $894,253.10; United Concrete Pipe Corp., Baldwin Park, $889,134. Contract awarded to Hess Construction Co., Inc., Long Beach, $761,903.77.

LOS ANGELES COUNTY—On Hollywood Freeway, between Cahuenga Boulevard and Gower Street, highway lighting and illuminated sign system to be furnished and installed. District VII, Route 2. Westates Electrical Const. Co., Los Angeles, $38,757; Newberry Electric Corp., Los Angeles, $38,413; Fischbach & Moore, Inc., Los Angeles, $37,802; Electric & Machinery Service, Inc., South Gate, $37,363; A. S. Schulman Electric Co., Los Angeles, $36,668. Contract awarded to C. D. Draucker, Inc., Los Angeles, $36,465.

LOS ANGELES COUNTY—On Pomona Boulevard between Ferris Avenue and Potrero Grande Drive about 2.3 miles in length to be graded and paved with asphalt concrete. District VII, Route 172-A. Griffith Co., Los Angeles, $364,979.40; Jesse S. Smith, Robert R. Hare & Service Const. Co. of Southern California, Burbank, $314,115.50; H & H Construction Co., Long Beach, $338,357.25; Vido Kovacevich Co., South Gate, $324,681.50. Contract awarded to Boddum & Peterson, Long Beach, $321,897.

MERCED COUNTY—Between Snelling and Stanislaus County line about 6.4 miles in length, a graded roadbed to be constructed and bituminous surface treatment applied thereto. District X, Route 919. Elmer J. Warner, Stockton, $147,358; C. V. Kenworthy, Stockton, $135,788; Chittenden & Chittenden, Auburn, $128,328; River Rock, Inc., Merced, $126,584. Contract awarded to United Concrete Pipe Corporation, Baldwin Park, $124,727.80.

MERCED AND STANISLAUS COUNTIES—Between Madera County line and Keyes about 23.4 miles in length, roadside areas to be prepared and planted. District X, Route 4, Section A, Merced, C, A. James E. Boothe, Compton, $53,860.79; Leonard Coats Nurseries, Inc., San Jose, $45,738.20; Dana R. Tyson Co., Sacramento, $43,855.61; Huettig, Schromm & Bennett, Palo Alto, $30,759.52; Jannoch Nurseries, Altadena, $30,079.25; Stephen L. Vistica, San Mateo, $25,063.65. Contract awarded to Richard J. Repsher & Sons, Paso Robles, $24,310.20.

SAN DIEGO COUNTY—At the intersection of National Avenue with Main Street and in the City of San Diego at the intersection of Federal Blvd. with 47th Street; full traffic-actuated signal systems and highway lighting to be furnished and installed and channelization to be constructed. District XI, Routes 2, 199; 200-F, A; S.D. Ets-Hokin and Galvan, San Diego, $40,657.35. Contract awarded to California Electric Works, San Diego, $39,931.70.

SAN DIEGO COUNTY—In the City of San Diego, at the intersection of Pacific Highway with Washington St., a two-phase full traffic-actuated signal system to be changed to a three-phase full traffic-actuated signal system, and channelization to be constructed. District XI, Route 2-S.D. California Electric Works, San Diego, $22,472; Westates Electrical Construction Co., Los Angeles, $21,601.50. Contract awarded to Ets-Hokin & Galvan, Inc., San Diego, $21,363.26.

SAN DIEGO COUNTY—Between Dulzura & Campo, about 0.8 of a mile in length to be graded and a B. S. T. to be applied. District XI, Route 200, Section D. Ralph A. Bell, Monrovia, $132,136; Morris S. Van Meter, Bonita, $108,257.76; Einer Bros., Inc., Escondido, $98,445.40. Contract awarded to Cox Bros. Construction Co., Stanton, $93,522.

SAN JOAQUIN COUNTY—Protective screening on state highway between Mariposa Road and Calaveras River and between D Street and Route 4, a length of 6.8 miles, District X, Routes 4, 5, E, Stockton, C, Stockton. Leonard Coates Nurseries, Inc., San Jose, $10,188.20; Stephen L. Vistica, San Mateo, $9,568.20; Dana R. Tyson Co., Sacramento, $8,042.35. Contract awarded to Huettig, Schromm & Bennett, Palo Alto, $5,634.45.

SAN LUIS OBISPO COUNTY—About 13 miles west of Atascadero, between 2.6 miles and 5.0 miles east of Route 56 about 2.3 miles in length, roadway to be graded, imported subbase material and I. B. M. to be placed and surfaced with B. S. T. District V, Route 125, Section A. Madonna Construction Co., San Luis Obispo, $185,580; Covina Construction Co., Covina, $170,516.25; Volpa Bros., Fresno, $164,513.78; Granite Construction Co., Watsonville, $160,385; M. J. B. Construction Co., Stockton, $144,999.70. Contract awarded to Valley Paving & Construction Co., Inc., Pismo Beach, $142,745.50.

SIERRA COUNTY—Between 6.3 miles east of North Yuba River Bridge and 4.5 miles west of Sierra City, portions, about 1.9 miles in net length to be graded and penetration treatment applied. District III, Route 25, Sections A & B. Richter Bros., Oroville, $246,890.70. Contract awarded to J. Henry Harris, Berkeley, $199,184.

SOLANO COUNTY—Protective screening on state highway between Ledgewood Creek and Alamo Creek, a length of 8.1 miles. District X, Route 7-B & C. Leonard Coates Nurseries, Inc., San Jose, $12,457.70; Stephen L. Vistica, San Mateo, $10,729.60; Dana R. Tyson Co., Sacramento, $10,356.30. Contract awarded to Huettig, Schromm & Bennett, Palo Alto, $9,726.24.

SONOMA COUNTY—Between Stewarts Point and Gualala, portions, about 2.7 miles in length to be graded, I. B. M. to be placed, and B. S. T. to be applied. District IV, Route 56, Section E. J. Henry Harris, Berkeley, $127,971.60; Arthur B. Siri, Inc., Santa Rosa, $102,993.55; Britt-Pugh, Ukiah, $98,265.24. Contract awarded to Huntington Bros., San Anselmo, $94,494.

SONOMA COUNTY—At various locations between Cloverdale and Santa Rosa, a net distance of about 8.9 miles to be graded and surfaced with P. M. S., District IV, Route 1-A & B. Frederickson & Watson Construction Co., Oakland, $414,982; Granite Construction Co., Watsonville, $362,444.10; A. G. Raisch Co., San Rafael, $292,845.30; M. J. Ruddy & Son, Modesto, $285,356.80. Contract awarded to J. R. Armstrong, El Cerrito, $278,948.46.

TULARE COUNTY—On Frazier Valley Highway, between Strathmore and 3.5 miles east, about 2.9 miles in length of roadway to be graded, imported subbase and base material to be placed, and surfaced with road mixed surfacing. Jesse S. Smith and Robert R. Hare, Glendale, $108,651; Wells & Fields Constructors, Visalia, $99,289.75. Contract awarded to Griffith Company, Los Angeles, $102,865.

F. A. S. County Routes

COLUSA COUNTY—Between 5.8 miles north of Colusa and Glenn County line, about 8.3 miles in length; portions to be graded and surfaced with plant mixed surfacing on imported base material and plant mixed surfacing to be placed over existing pavement on other portions of the project. District III, Route 761. A. Teichert & Son, Inc., Sacramento, $180,271; Clements & Co., Hayward, $158,447. Contract awarded to Harms Bros., Sacramento, $156,714.

GLENN COUNTY—Across Elk Creek, about 24 miles west of Willows, a reinforced concrete slab bridge to be constructed. District III, Route 1117. Chittenden & Chittenden and B. S. McElderry, Auburn, $28,914; O'Connor Bros., Red Bluff, $27,254; Eaton & Smith, San Francisco, $26,973.20; Barton Construction Co., Oakland, $23,655. Contract awarded to James H. McFarland, San Francisco, $21,571.

KERN COUNTY—On Main Drain Road, between Lerdo Highway and Bakersfield—McKittrick Highway, about 9.4 miles in length to be graded and a penetration treatment applied. District VI, Route 895. Oilfields Trucking Co. & Phoenix Construction Co., Inc., Bakersfield, $405,040.90; Volpa Brothers, Fresno, $378,369; Griffith Company, Los Angeles, $349,101. Contract awarded to Covina Construction Co., Covina, $328,294.98.

LAKE COUNTY—Between 7.0 miles and 3.5 miles west of Lower Lake, about 3.5 miles in length to be graded and drainage facilities installed. District I, Route 1039. O'Connor Bros., Red Bluff, $66,789; Chittenden & Chittenden, Auburn, $38,836; Carey Bros. Construction Co., San Anselmo, $37,883; Vega Engineering & Grading Co., Berkeley, $36,025; Arthur B. Siri, Inc., Santa Rosa, $34,075.95; Britt Pugh, Ukiah, $31,847.50. Contract awarded to Harold P. Hastings, Lakeport, $18,951.50.

MADERA COUNTY—On Firebaugh Madera Road, between Firebaugh Bridge and 3 miles east, about 3 miles in length, to be graded and surfaced with road mixed surfacing on untreated rock base. District VI, Route 811. Volpa Brothers, Fresno, $96,086; P. J. Moore & Son and Floyd O. Bailey, Tracy, $93,000.50; Baun Construction Co., Fresno, $91,505; Gerald F. Brewster, Avenal, $89,440. Contract awarded to M. J. Ruddy & Son, Modesto, $83,325.

RIVERSIDE COUNTY—On Hole & Holden Avenue, between West Riverside city limits and Arlington Avenue, about 3.6 miles in length to be graded, cement treated base to be constructed and surfaced with plant mixed surfacing. District VIII, Route 701. George Herz and Co., San Bernardino, $190,555.30; Matich Bros., Colton, $171,682.50; E. L. Yeager Co., Riverside, $166,308.50. Contract awarded to R. A. Erwin, Colton, $164,082.50.

LOTS OF WATER

The combined capacities of Shasta Lake behind Shasta Dam and Millerton Lake behind Friant Dam will provide 25 gallons of water for every man, woman and child in the United States every day for one full year.

Commissioner Harrison Baker points to cornerstone of Francisco Street bridge which was start of Harbor Freeway in 1948

Busy Day

Continued from page 16 . . .

Commission was Mr. Baker. He stressed the fact that this highway's early construction was due to the cooperation of the people of Long Beach and the Division of Highways. Mr. Baker also stated the cooperation, such as this, really made the work of the commission and the Division of Highways much easier.

Assemblyman Wm. Grant lauded the commission and the Division of Highways and said that it had been his privilege to work with both bodies of men and he was sure, in his mind, that a wonderful job was being done for Long Beach and the entire State.

George T. McCoy, State Highway Engineer; Mayor Burton W. Chace of Long Beach, and D. W. Campbell, Manager of the Long Beach Chamber of Commerce, also spoke.

As soon as the ceremonies were over, the caravan left for Garden Grove and lunch with representatives of Orange County. After lunch, the entire assemblage left for Riverside to meet with representatives of Riverside County and from there they left to meet with representatives of San Bernardino County.

WATER FESTIVAL

Water spilled from Shasta Dam into the Sacramento River on August 1st will open the great 10-day Central Valley Water Festival, August 1st-10th, inclusive.

Men and machines are speeding work on the Tracy Pumping Plant, where six of the world's largest pumps will lift a river-sized stream of water 200 feet from the valley floor into the Delta-Mendota Canal. The Tracy Pumping Plant will be the scene of one of the major celebrations of the Central Valley Water Festival, August 1st through 10th.

U.S. 40

Two Remaining Sections of Two-lane Highway Soon Will Be Eliminated

By M. C. FOSGATE, Assistant District Engineer

California Highways and Public Works magazine published in its March-April, 1950, issue an article by District X reporting on the opening of 13 miles of limited freeway completed on U. S. 40 during 1949. This article stated, in part: "All two-lane road is eliminated between Sacramento and the Bay region with the exception of that portion between Ledgewood Creek and Cordelia, a distance of 5.24 miles, and a short section between Ulatis and Alamo Creek, 1.4 miles. It is hoped both of these remaining sections will be under contract before July 1st of this year (1950)."

Another article in the November-December, 1950, *California Highways and Public Works* magazine described the Cordelia project. The following explains progress on that unit as well

Grading two additional lanes for four-lane divided highway. Looking easterly from Vacaville.

Railroad bridge under construction near Cordelia Wye which is in background

This is the north entrance to the outer highway at the Nut Tree

Grading for outer highway near Vacaville-Dixon substation of Pacific Gas & Electric Company

as the other unit at Vacaville which was contracted for in February, 1951. Also other work in completing this important freeway is reported on.

Will Be Completed This Fall

On the section between Ledgewood Creek and Cordelia, the major portion of the paving is completed after some delays due to cement shortages. The underpass under the Southern Pacific Railroad near Cordelia is 90 percent complete, and the overpass carrying Route 12 traffic over Route 40 is nearing completion. Progress on all items of work on this project has also been hampered by the limited supply of labor available. However, it is expected this road will be open to traffic this fall.

The section at Vacaville between Ulatis Creek and Alamo Creek has the grading 100 percent complete. The overpass across the railroad and Mason Street is started. Piles for this structure have now been received. A detour was added during construction over about one-half of the distance of this section which allows the construction of the entire roadway without interference or inconvenience to traffic.

Detour Aids Project

It was necessary to construct a temporary structure across Alamo Creek to accommodate this detour. Due to a shortage of steel it is anticipated that the overhead and bridge on this contract will not be completed prior to January 1st. However, because of the revised detour the contractor will be able to lay his concrete paving completely to the paving notches in the structures which will mean as soon as the structures are completed traffic may use the new highway. As it is anticipated the section between Ledgewood Creek and Cordelia will have been completed prior to this time, this will then eliminate all two-lane highways on Route 40 between the Bay area and the causeway near Sacramento.

Leading toward the development of a full freeway, further progress has been made toward better access control in this area. A frontage road has been completed at the Nut Tree east of Vacaville with necessary chain link fencing. Traffic stopping at this famous eating place is now properly directed in and out from entrances on the westbound lane. These entrances are approximately 500 feet on either side of the Nut Tree, which also includes a service station. Cross-overs were also constructed from the northbound lanes opposite these entrances.

Frontage Road

To further protect traffic on this route, a frontage road is being constructed from a county road adjacent to the Vacaville P. G. & E. Substation to 4,000 feet west. This is an area where many small businesses and service stations exist. The entrances from this frontage road both enter the westbound lane on county roads where traffic islands, curbs, and fencing will protect the traffic on Route 40 from illegal entrance.

This contract is well along, the grading being complete, and the base and surfacing will be under way shortly. It is expected this contract will be completed early this fall. This contract also includes fencing at several locations between Vallejo and Davis to protect the traffic on this route from illegal movement of vehicles entering and leaving private businesses.

Miscellaneous other traffic features now under way or to be made a part of contracts now advertised include landscaping and erosion control between Ledgewood Creek and Alamo Creek; illumination in the vicinity of Vacaville, and installation of truck scales near Cordelia.

The completion of these above items and further planned access restrictions will soon see U. S. 40 handling its increasingly heavy traffic safely and expeditiously.

FROM SPAIN

MANUEL MATEOS
Canteras Graniticos y Microgranitícos
(Spain) Avila

FECHA, June 23, 1951

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: I wish to express my sincere thanks for your kindness in mailing me the January-February and March-April issues of your useful magazine *California Highways and Public Works*. I have always found it extremely helpful for my interest in its questions. I know how your Country is in the vanguard about highways, and I would be pleased to continue receiving copies.

Yours truly,

MANUEL MATEOS

EARL WARREN
Governor of California

•

FRANK B. DURKEE
Director of Public Works

•

HIGHWAY COMMISSION

HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego
R. C. KENNEDY, Secretary . . . . . Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . . State Highway Engineer
R. M. GILLIS . . . . Deputy State Highway Engineer
CHAS. E. WAITE . . Assistant State Highway Engineer
EARL WITHYCOMBE . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
F. N. HVEEM . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
E. T. TELFORD . . . . Engineer of Design
DON G. EVANS . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
J. P. MURPHY . . . . Principal Highway Engineer
E. J. SALDINE . . . . Principal Highway Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

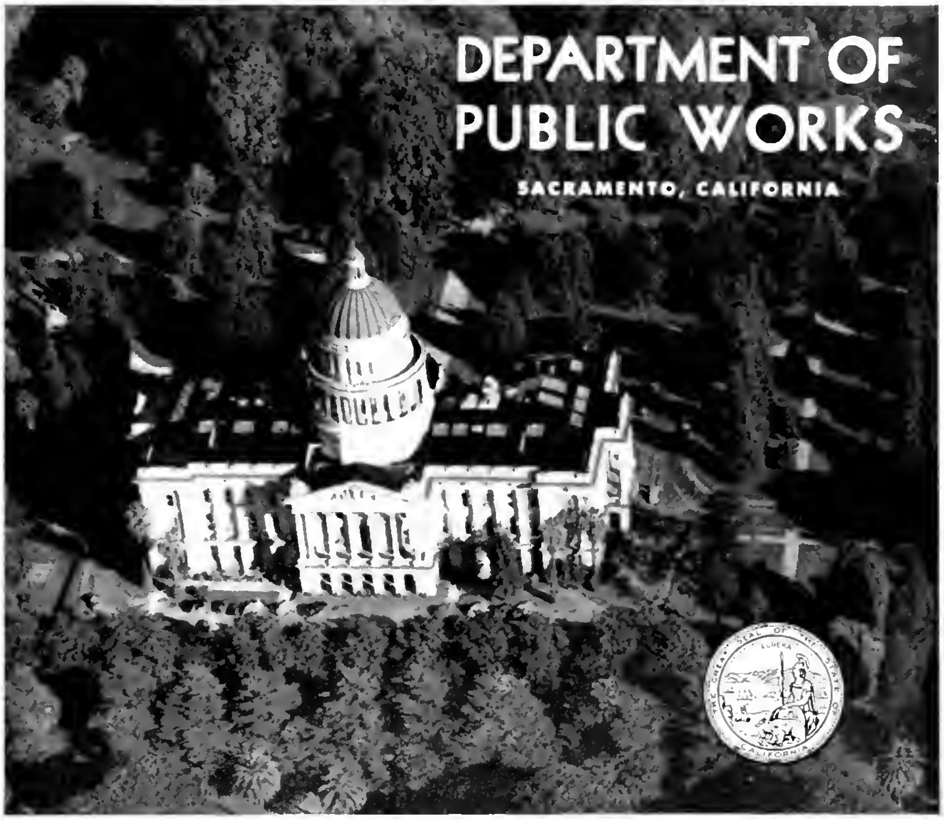
District VII

P. O. HARDING . . Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
S. W. LOWDEN . . . . District VIII, San Bernardino
ALAN S. HART . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge



DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO TOLL CROSSINGS

NORMAN C. RAAB . . . . Project Design Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . . State Engineer, Chief of Division
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
HARVEY O. BANKS . Supervising Hydraulic Engineer, Water Pollution Control Investigations
WILLIAM BERRY
Supervising Hydraulic Engineer, California Water Plan
MAX BOOKMAN
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
H. S. HUNTER . . . . Deputy Chief
ROBERT W. FORMHALS
Administrative Assistant to State Architect
EARL W. HAMPTON . Supervisor of Contract Architects

Administrative Service

W. K. DANIELS . Assistant State Architect, Administrative
WADE O. HALSTEAD
Principal Estimator of Building Construction
CARLETON PIERSON . . Supervising Contracts Writer

Planning and Design Service

P. T. POAGE
Assistant State Architect, Design and Planning
A. F. DUDMAN . . . Principal Architectural Designer
CARL A. HENDERLONG
Principal Mechanical and Electrical Engineer
C. L. IVERSON
General Supervising Architectural Draftsman
ELLIOTT ADAMS . . . Architectural Property Analyst
WALTER E. LORD . Supervising Specifications Writer
JAMES A. GILLEM . Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT . . . . Chief Construction Engineer
F. A. JOHNSON . . . . Principal Structural Engineer
JOHN S. MOORE . . . General Construction Superisor
NATE W. DOWNES
Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN . . . . Area I, Oakland
W. H. EPPERSON . . . . Area II, Sacramento
FRANK R. AUSTGEN . . . . Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD . . . . Area I, San Francisco
M. A. EWING . . . . Area II, Sacramento
H. W. BOLIN . . . . Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 46703 7 51 29 20

California Highways and Public Works
DIVISION OF HIGHWAYS
P. O Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

Seattle Public Library,

Seattle,

Wash.

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

If all the man-made forest fires in California in 1950 had been in a space one mile wide along the route of U. S. 101, you would have to drive for two days to see all the blackened waste. It would stretch for 745 miles, or from Los Angeles to near the Oregon line.

The mile-wide strip of ruin would represent the 477,000 acres of forest, range and watershed lands that were swept by the 2,867 fires resulting from human carelessness. They were 70 percent of all forest fires in California last year, according to a study made by the California Division of Forestry and the U. S. Forest Service. The other fires were due to lightning.

The man-made fires are preventable fires, the foresters point out. They ask all the people who travel through or work in California forest and range areas this year to prevent such fires by memorizing and observing these simple rules:

Hold your match and feel it before discarding.

Crush out tobacco butts in mineral soil. In autos, use the ash tray.

Drown your campfire; stir it; drown it again.

To burn trash or brush, get a permit from the nearest fire protection officer; then notify him before you start the burning.

Remember . . .

Only you can PREVENT FOREST FIRES!

CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

September — October, 1951

1883 *Charles Henry Purcell* 1951

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK B. DURKEE, *Director* — GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. BOX 1499
Sacramento, California

Vol. 30 September-October Nos. 9, 10

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

CHARLES HENRY PURCELL

California Highways and Public Works dedicates the cover page of this issue to the revered memory of Charles Henry Purcell. Mr. Purcell, who retired as Director of Public Works on July 31, 1951, died suddenly from a heart attack in his home in Sacramento on September 7th.

Informed of Mr. Purcell's death, Governor Earl Warren epitomized the deep feeling of loss of the people of California in the following tribute:

"He was a great citizen. He devoted his entire life to public service and eventually gave his life to his State. But the great public works he planned will be a lasting monument to his memory."

Manpower

Division of Highways Personnel Informed of Future Program

By CHAS. E. WAITE, Assistant State Highway Engineer

Following World War II California entered into a tremendous program of highway development, unprecedented in state and national history. The program required a large increase in the Division of Highways' engineering organization and associated personnel. With the continuing engineering manpower shortage following World War II and because of the present unsettled world conditions which have caused further attrition of engineers, the division has been hard pressed to meet the planning and construction schedule for state highways.

Believing that highway transportation is the backbone of the nation's defense, the Division of Highways has felt compelled to proceed with correction of its most critical highway deficiencies. In the event that material shortages and other events result in a slow-down of highway construction, the division proposes to revise its program, and will utilize available funds for completion of plans and purchase of rights of way for future projects.

Manpower Situation

To relieve the uncertainty in employees' minds concerning the immediate future highway program and also to inform all employees of the engineer manpower situation, two letters, dated March 28, 1951, and September 25, 1951, which are published herewith for wider dissemination, were addressed to the department heads and district engineers.

It is believed the information in the letters is of interest to all persons concerned with California highway development.

To: Department Heads and
District Engineers

Because of the possibility of some curtailment of construction as a result of the defense program, many questions have arisen concerning our manpower needs and the possibility of a reduction in our personnel.

In order that all of our employees may be fully informed concerning our policy on this important matter, you may inform them that in the event construction work is curtailed or reduced we will proceed to step up our planning and right of way programs to the fullest extent.

Our experience along these lines during the last war clearly indicated the need of all of the available personnel we had or were able to recruit. The advantages of having plans prepared well in advance are recognized by all.

We will continue our recruitment program to be prepared for any contingency. Although there may be a curtailment of construction work, we plan to utilize our entire forces and no layoff of personnel can be considered in the foreseeable future.

G. T. McCOY
State Highway Engineer

To: Department Heads and
District Engineers

Our recent recruiting experiences, coupled with published information concerning the number of engineering graduates who will be available during the next few years, indicate that it will be increasingly difficult to secure as many junior civil engineers as we need. As a result, it will be necessary for all supervisors to make every effort to see that the best possible use is made of all engineering personnel and that as many functions as possible are performed by employees in other classifications.

The last two junior civil engineer examinations, which were given on a nationwide basis in March and June of this year, resulted in lists of 927 and 373 names. Out of these 1,300 eligibles, a total of 675 were appointed to positions. Of these, 476 were new to the organization and 199 were promoted from lower grades. While the number of new recruits obtained from these examinations was above average, it was still about 250 less than the number for which we have requests.

Employment Records

An analysis of employment records for the first seven months of this year indicates that the turnover rate for junior civil engineers is now between 25 percent and 30 percent per year. While it is expected that the rate for such a beginning professional class will be higher than the 5 percent or less for which industry strives, this figure is high enough to raise the question of whether we as employers are doing everything possible to retain men in this grade.

Current articles on the availability of new engineers (all types) during the next few years emphasize the 1951 report of the Engineering Manpower Commission of the Engineers' Joint Council, which states that the number of engineering graduates is expected to drop from the high of 52,000 in 1950 to between 12,000 and 17,000 in 1954. Nothing much can be done to improve the 1954 figure, nor the 25,000 and 19,000 figures for 1952 and 1953, since these classes already are in college. To make matters worse, if present draft policies continue, out of the 12,000 graduates in 1954, only 6,000 (not just civils—all types!) may be available to fill all of industry's needs.

Discouraging Figures

These figures are very discouraging, particularly when it is realized that the present shortage of new engineers is estimated to be 60,000 and that 30,000 per year are required for normal replacement and growth at the present rate. Aggravating the situation is the fact that the ratio of engineers to production workers is increasing steadily so that the number of new engineers needed each year is increasing more rapidly than total employment.

A national program for alleviating the shortage as soon as possible has been developed by the U. S. Labor Department, in cooperation with the Engineers' Joint Council and other interested groups. This program includes several points, among which are the following: (1) Making maximum use of engineers already employed, (2) making better use of supporting non-engineering personnel, (3) making more exhaustive use of training facilities.

In order to maintain our organization as well as possible it is planned to continue an active recruiting program on a nation-wide basis. Training and rotation of engineering personnel must be given more emphasis in order to reduce the turnover rate. In addition, it will be necessary for all supervisors to be alert at all times to any opportunities for making better use of engineering personnel or substituting other classifications.

CHAS. E. WAITE
Assistant State Highway Engineer

Footpath to Freeway

U. S. 99 in Siskiyou Gets Improvements

By P. F. DUFFY, Assistant Highway Engineer

FROM A FOOTPATH to a freeway, would in a few words tell the story of the Pacific Highway, U. S. 99, through Northern California. More than a hundred years of travel mark this route, on which plans are being completed for 4.92 miles of reconstruction in southern Siskiyou County between Spring Street in the Town of Dunsmuir and Big Canyon.

The trappers of the 1830's blazed the way for what was to become one of the routes of the California-Oregon Trail. The pack trains and ox carts of the pioneer settlers wore deep the ruts that marked the way of this major interstate route, traveled today by a continual stream of passenger cars and trucks. The design standards employed at the time the present highway was constructed are far short of those required for the volume and type of traffic daily using the highway, and the planned reconstruction has long been needed.

First Road in 1860

The Pacific Highway leaves Redding at the head of the Sacramento Valley to cross over mighty Shasta Lake near the junction of the Pit and McCloud Rivers and thence ascend the rugged Sacramento River Canyon to Dunsmuir. Beyond Dunsmuir the highway passes through Upper Soda Springs and Shasta Retreat to Shasta Springs, and northward past Big Canyon and along the westerly slope of Mount Shasta, on into Oregon.

The first effort at a road through this area was in 1860 when a stage road was completed from Yreka in northern Siskiyou County to Upper Soda Springs, and from there down the Sacramento River Canyon. With the coming of winter floods, the bridges through the Sacramento Canyon were carried away and it was not until 1870 that stage travel became permanently established through the entire length of the Sacramento Canyon.

Upper Soda Springs, which served as the terminus for the stage line from Yreka, is located on the north bank of the Sacramento River, just a short distance upstream from the present highway bridge at Dunsmuir. A part of the old stage road is still in existence and can be seen crossing underneath the bridge in the background of the accompanying photograph. The old toll bridge crossed the river just a few feet downstream from the present highway crossing.

Improvement of traffic congestion in Dunsmuir sloted as future project

Realignment of U. S. 99 will begin one block south of this curve in Dunsmuir

Old Freight Station

Upper Soda Springs gained its name from the springs rising along the river bank, and was once a campground of Hudson's Bay Company trappers. The ancient soda springs with their health-giving waters were a rendezvous for the Indians long before the coming of the first settlers. Here Ross and Mary McCloud first settled in 1855, and the freight station which they built in 1864 remained a popular resort until the early 1920's. The old freight station still stands, and descendants of these early settlers still own and live on the property.

Approximately two miles north of Dunsmuir, midway of the portion of highway to be reconstructed, is Shasta Springs and beautiful Mossbrae Falls. Surrounded by towering pines and cooled by gentle breezes, Shasta Springs Resort was for many years a noted stopping place. The property was purchased by the Saint Germain Foundation in 1950 and has been closed to the public.

A celebrated carbonated water, high in content of iron and magnesia, is bottled and distributed from here. Nearby Mossbrae Falls differ from all others in California, their waters rising amid ferns and moss to cascade down the green mountainside.

Dunsmuir, founded in 1886 with the coming of the railroad, has for many years been a division point for the Southern Pacific Railroad.

Dunsmuir was named for Alexander Dunsmuir, a wealthy coal baron from British Columbia. Passing through in 1886 when the town was little more than a railroad siding and station house, Dunsmuir said he would give them a fountain if they would call the place Dunsmuir. They did, and the fountain erected in a plot adjoining the railroad station still remains.

The town draws its chief support from railroad employment, as well as being a supply center for hunters and fishermen who throng this region which abounds with fish and game. For many years development was principally on the westerly slope above the river, centered about the railroad station and engine roundhouse.

High Level Bridge

In 1915 the highway improvement and construction of a high level bridge across the Sacramento River opened the way to development of a new area across the river to the north. Development is nearly continuous along the highway for about a mile north of town. The municipal swimming pool and baseball field are located along the highway, as well as a number of motels and tourist resorts and other commercial enterprises. Westerly from the highway, overlooking the river, is a large residential area. Most of the present improvements are in this section.

In 1896 the State Bureau of Highways, created the year previous by act of the Legislature, mapped out a proposed State Highway System of which the main north-south artery was what is now U. S. 99, extending through the length of California from Calexico on the International Boundary Line of Mexico to the Oregon state line north of Yreka. The stage road of 1870 was gradually improved as a county road and remained in use until 1915. In that year the portion of U. S. 99 between Dunsmuir and Weed, a distance of 16.67 miles, was graded on new alignment, and the following year the present bridge across the Sacramento River

Existing portion of old stage road referred to in accompanying article may be seen in background

at Dunsmuir was constructed to replace the old county bridge which crossed the river approximately one-half mile downstream.

Steady Traffic Increase

The highway was maintained as a graveled road until 1922, when 18-foot wide concrete pavement was constructed, the contract being performed by Henry J. Kaiser. This road is in use today, and, except for minor widening, there has been no improvement to bring it up to the standards needed for present traffic demands.

In July of 1914 the report prepared by T. A. Bedford, then district engineer for District II, tells us "traffic consists principally of the summer tourists passing north and south through the country and some light pleasure vehicles between the towns along the line." By 1921 traffic had increased to where it was estimated to be 500 vehicles per day, but still remained principally passenger vehicles, tourists, and local traffic. Even at that late date little did anyone anticipate that traffic through this mountainous region would increase by leaps and bounds, and that the highway built to accommodate the tourists and intercity travelers would be called upon to carry huge trucks loaded with logs and lumber, freight, and produce, the wealth of California's hills and valleys flowing to the market centers. Traffic counts taken in July, 1951, at a point just slightly north of Big Canyon, indicate an average daily traffic of approximately 4,000 vehicles, of which some 16 percent are trucks or buses. This would mean that combined with the flow of passenger cars are trucks and buses spaced at approximately two-minute intervals.

Much Needed Improvement

The need for improvement on U. S. 99 has long been recognized. The need is not confined to this section being designed, but extends from Crespo's at the upper limits of Shasta Lake to the town of Mount Shasta, a distance of some 36 miles. Between Dunsmuir and Big Canyon was determined as being the more critical portion for here the highway combines sharp curves with short intervening tangents and a sustained grade, nearly one-half mile of which is 7 percent.

Hazardous in themselves, these conditions become even worse during the winter months when the highway is subject to ice and snow. The steep grades cause trucks to travel at low speed, and the winding alignment causes long lines of traffic to collect behind the trucks. All too frequently some foolhardy driver, becoming impatient with the delay, swings out to attempt to pass the line of traffic, endangering both himself and others, for the winding road does not permit a clear picture of what onrushing traffic may be just ahead. Trucks descending the grade are warned by signs to shift to low gear, but even so there are repeated cases of trucks going out of control and crashing off the highway.

Dunsmuir Traffic Congested

Within the town of Dunsmuir traffic travels along the main business street, only 40 feet in width with some 16 feet of this width devoted to parking area. One can readily visualize the congestion when through traffic is increased by a heavy local traffic, and further inconvenienced by traffic entering from the many intersecting streets.

. . . Continued on page 64

Freeway Values

Abutting Properties Show Exceptional Gains

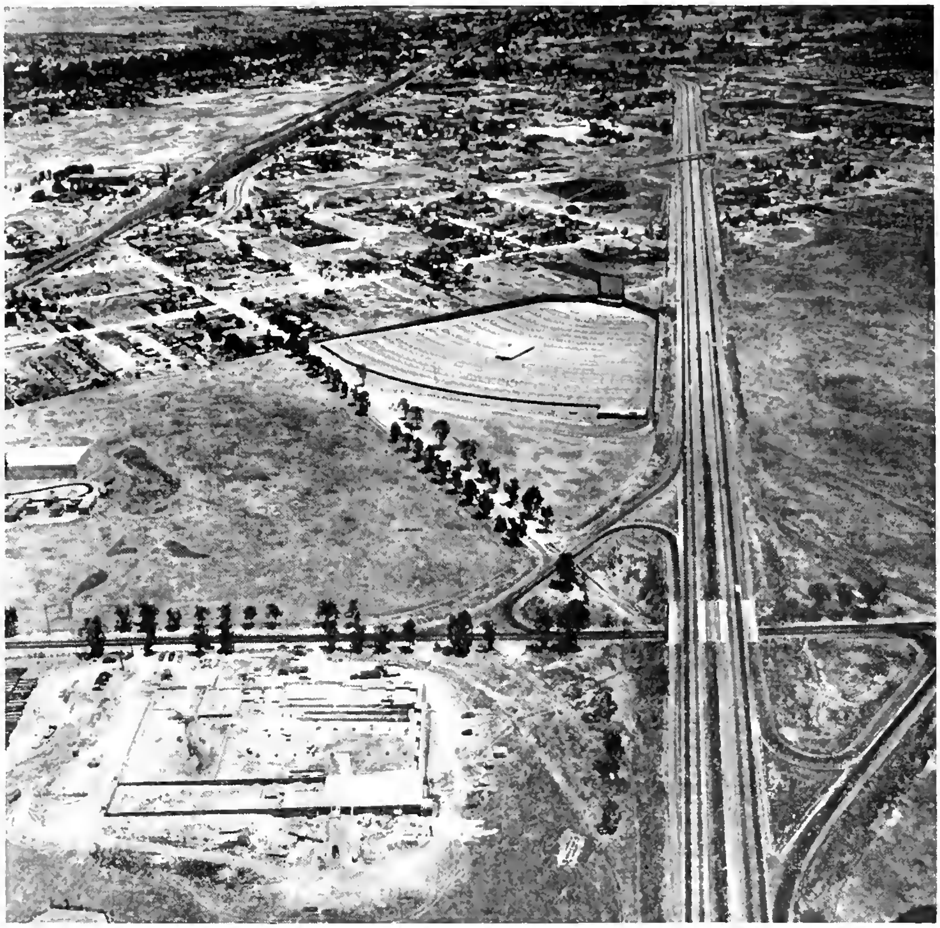
By W. STANLEY YOUNG, Headquarters Right of Way Agent

WHAT ARE the effects of a by-pass on property values?

This question has been answered pretty conclusively in the several studies published in previous issues of this magazine. In these studies we learned of the substantial benefits to both property values and retail businesses by such a segregation of through and local traffic. (See January-February, 1950 issue of *California Highways and Public Works.*)

But what are the effects of the freeway on the properties through which it is built—properties on which severance damages have been frequently demanded in the past?

The nationally known Continental Baking Company's acquisition of the seven-acre site on which to build its new $1,600,000 plant adjacent to the North Sacramento Freeway is a pretty good indicator of the answer to this question. This property has no access to the highway, but is served directly only by an intersecting county road connected to the freeway by means of a traffic interchange structure.



Aerial photograph looking northeasterly along the North Sacramento Freeway, shows the $1,600,000 Continental Baking Plant under construction in the left foreground

Striking Example

This slightly more than seven acres, as a part of larger holdings, was worth only about $600 per acre as late as 1947. About two years after the freeway opened, slightly less than 42 acres, including the baking plant site, was grabbed by a very astute local land developer for approximately $1,100 per acre.

Only one year later seven acres of the larger property were purchased for the baking company by one of the Nation's leading property appraisal and acquisition agencies, specializing in large commercial and industrial locations. The price paid for this property, considered in competition with all other available industrial sites in the Sacramento area, of which there are many, was approximately $7,100 per acre.

Value Now $10,000 Per Acre

The question may be raised as to whether or not this is an isolated example not characteristic of the rise in values of properties adjacent to the freeway. Indicative of the answer is the fact that property just north of the Continental Baking Plant site, visible in the left center of the accompanying aerial photograph, is presently for sale at the rate of $10,000 per acre. It may be seen in the photograph that this property does not adjoin the freeway but yet has the valuable advantages of the excellent transportation facilities and advertising value of visibility to more than 40,000 motorists per day, as well as the rail facilities which existed in the years prior to the freeway when the land was only worth a fraction of its present value.

Unquestionably the freeway was the principal reason for the rapid rise in property values in this area. Only in areas served by the freeway have similar general value increases been registered in the Sacramento area.

Advertising Value

Some indication of the advertising value of visibility from the freeway

. . . Continued on page 58

Siskiyou Job

New Section of U. S. 99 Between Spring Hill and Weed Opened

By H. CLYDE AMESBURY, District Construction Engineer

CELEBRATING completion of a project on U. S. 99 between Spring Hill and Weed in Siskiyou County, brief dedicatory ceremonies opening the new stretch of highway to traffic were held on September 17th at a scenic spot near Black Butte.

The new highway, which is eight miles in length, and for which surveys were started 10 years ago, fulfills a critical need and culminates a development proposed by citizens of Siskiyou County and state highway officials. The cost of the project was $1,114,150.

Senator Randolph Collier, heading a group of citizens, community leaders and industry representatives, formally opened the project with the remark, "In the name of the taxpaying public of the great State of California, we add this new link to the State Highway System."

Started in 1944

Preparation of plans for the work was undertaken in 1944 as a proposed postwar project but funds to construct did not become available until augmented revenues were obtained following passage of the Collier-Burns Highway Act in 1947.

In 1949 a contract for grading the 4.4 midsection miles and constructing the Black Butte Overhead was awarded to Harms Bros. and F. Fredenburg and was completed that year at a cost of $383,489.

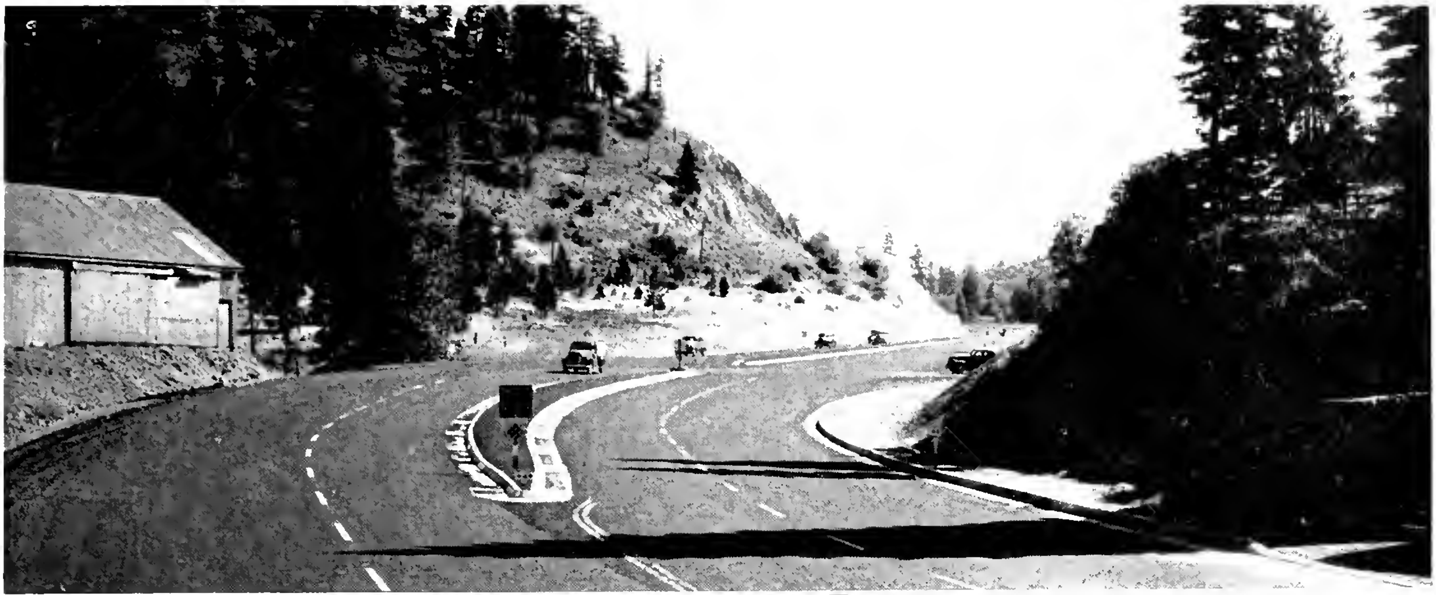
A contract for $448,728 was awarded to the Rand Construction Co. in 1950 to complete the grading on both ends of the previous contract and to pave the entire length. The construction schedule which contemplated completion prior to the 1950-51 winter season was not met, necessitating a second construction season to complete.

New Alignment

The new road, mostly on new alignment, has a driving surface 40 feet

. . . Continued on page 64

Black Butte realignment between Shasta City and Weed, looking south past Black Butte



UPPER—This section of Black Butte realignment is looking south from Weed. CENTER—Ribbon-cutting participants, front row, left to right: Mrs. L. Sobarbra, Mrs. O. Apperson, Mrs. Dom Siriano, Mrs. C. B. Rippon, F. W. Haselwood, former District Highway Engineer; Senator Randolph Collier, Louis Sobarbra, Dom Siriano. BOTTOM Construction here was across sawdust dump.

Redding-Red Bluff

Highway Expenditures Now Total $3,337,222

By J. W. TRASK, District Engineer

To REDDING, Shasta County, more than most communities, transportation has always been of vital importance. In fact, a change in means of transportation caused Redding to come into existence.

More than a hundred years ago, there were just four main towns in the State.

J. W. TRASK
District Engineer

These were San Francisco, Sacramento, Marysville, and Shasta. Shasta while not the largest probably had the most brick buildings. Los Angeles was only a little Mexican pueblo.

Shasta was located at the place where wagon trains delivered their goods to waiting pack trains that transported the merchandise to Weaverville, Hayfork and communities clear up to Oregon.

Then the Southern Pacific Railway came through. It established a town site and caused the train to stop at "Reading," but the name was misspelled and Redding was born. Shasta never recovered from this blow.

These are the old and new South Redding underpasses

Far-Sighted Plan

This year has seen the completion of a far-sighted plan on the part of the Division of Highways to complete the first phase of the new Redding-Red Bluff Highway. The entire section has been realigned and reconstructed and a four-lane divided highway has been built from Redding as far as one-half mile south of Anderson.

The first step toward this accomplishment occurred in 1937 when the Division of Highways awarded a contract to N. M. Ball Sons for $196,839 which covered the construction of the present South Redding underpass and about one-half mile of four-lane divided concrete paving. This project was a Bridge Department contract. M. Fredericksen, now Assistant Office Engineer at Sacramento, had charge of grading, paving and minor structures. In the light of existing traffic, the structure and divided highways looked pretty optimistic. Travel coming to and leaving the structure got along

comfortably on a single lane of 15-foot concrete pavement built by Henry J. Kaiser. The vision that justified the size has been amply proven. The improvement is still adequate.

Rains Made Going Tough

In 1940 the division awarded a contract for a four-lane partially divided highway from Hill Street in Redding to the section that had been completed near the underpass. Fredrickson and Westbrook were the contractors and the contract amounted to $125,841. Fred Drinkhall, since deceased, was the Resident Engineer.

The contractors succeeded in completing the south-bound concrete lane before the winter rains began. Northbound traffic was carried over the gravel base. That winter we had 63 inches of rainfall. Sometimes travelers felt that "floated" more nearly described their passage over the unpaved portion. None of those connected with the construction nor those who had to travel it are likely to forget that project. It was finally completed the next summer. The balance of the islands which were necessary to make it a divided highway were placed in 1950 under the contract just completed.

Clear Creek Project

Then a contract was let for a southbound lane from the underpass to one-half mile south of Clear Creek in 1943. This was awarded to A. Teichert & Co. for $232,931. C. I. Brown, now Supervising Engineer in District V, was Resident Engineer. Large quantities of water were encountered in this construction. The adequacy of the corrective measure taken by the engineers is proven by the fact that no failures have ever occurred in this section.

In 1948 Fredrickson & Watson received a contract for five miles of work between Anderson and Cottonwood for $611,709. J. H. Creed, now Engineer of Surveys & Plans in District IX, was the Resident Engineer.

In 1949 a contract was let to Fredrickson & Watson for constructing the westerly or southbound lane from Anderson to Clear Creek. H. B. Milner was Resident Engineer until he was promoted to Assistant Design Engineer at Sacramento. The amount was $796,464. The contract also covered the moving of all the buildings on the west side of the street in Anderson and the construction of a service road in this location.

Building Removal Project

This was a situation that was practically forced upon the Division of Highways. It was necessary to move these buildings to arrange for the southbound lane. If they were moved back only enough to allow for this construction, all development would be hampered by the knowledge of owners that, before too long, they would face another upheaval and a move further back. To acquire two parcels from the same frontage would appear to be devoid of real planning as well as costly. It was therefore decided to make one operation, whereby required right of way was secured at one time and a completed improvement made through Anderson.

The result has been gratifying. The type of buildings and the amount of improvement has been much above that which existed previously.

The rest of the contract was only out of the ordinary in respect to the amount of water encountered. Even the Caterpillar tractors became mired almost daily in the grading operations.

UPPER—Old intersection of U. S. 99 and State Route 44 in Redding. LOWER—The new intersection.

The engineers raised grade through some areas, installed miles of drainage pipe and took other measures where necessary and were successful to the extent that the second year of heavy traffic has revealed no weak spots.

Canal Moved

Under this contract, with a real assist from the weather, the contractor moved back and lined two portions of the A. C. I. D. Canal. This work had to be done between the time that irrigation water could be turned out of the canal and the time that winter rains began. By doubling up his equipment and working overtime he was able to get their work completed.

In 1950 the contract that was just completed was awarded. Fredrickson & Watson through having their equipment and paving plant on the ground were low bidders for $646,601. W. Z. Hegy, now Maintenance Engineer in District II, was Resident Engineer. Besides the grading and paving of the northbound lane from Anderson to Girvan, the work included a new Clear Creek Bridge and widening the existing Clear Creek, A. C. I. D. Canal, Spring Creek, Oregon Gulch bridges and installation of islands in the pavement north of the underpass to provide a divided highway. No particular difficulties were encountered in any of this construction.

Total Expenditures in Shasta

The total expenditures in Shasta County since the realignment and reconstruction of the highway between Redding and the southerly Shasta County line is as follows:

1937	$196,839
1940	125,841
1943	232,931
1948	611,709
1949	796,464
1950	646,601
Total	$2,610,385

On the Tehama County end, work was performed under two contracts. In 1940 Jones and King received an award for $218,000 to complete about six miles immediately north of Red Bluff. R. R. Norton, now Assistant Office Engineer at Sacramento, was Resident Engineer. In 1946 the Phoenix Construction Company and Oilfields Trucking Company secured a contract for the next 7.1 miles for $508,837. F. S. Saunders, now Office Engineer District II, was the Resident Engineer.

There was nothing particularly noteworthy about either of these contracts. In the aggregate they called for handling 773,000 cubic yards of red dirt that disintegrated into very offensive dust during the summer and lost all bearing value just as soon as the rains hit it. They called for hauling in 228,000 tons of gravel and placing 41,000 tons of paving. Just all in the day's work as far as modern contract firms are concerned.

UPPER—View of Anderson before construction of divided highway. LOWER—After improvement.

Expenditures in Tehama

Total expenditures in Tehama County.

1940	$218,000
1946	508,837
Total	$726,837

This gives a total expenditure in Shasta and Tehama Counties of $3,337,222 on the Redding-Red Bluff highway since the realignment and reconstruction was begun in 1937.

This highway is a link of the north and south interstate highway. Eventual improvement to at least four lanes of divided highway is even now visioned for its entire length. Additional lanes

. . . *Continued on page 56*

State Buys Spans

San Mateo-Hayward and Dumbarton Bridges Purchased for $8,250,000

Simple flag raising ceremonies on both spans at 10.50 a.m., September 12th, signalized the taking over by the State of the San Mateo-Hayward and Dumbarton bridges across southern end of San Francisco Bay. A celebration in which officials and citizens of Alameda, San Francisco, San Mateo and Santa Clara Counties were to have participated under sponsorship of the Hayward Chamber of Commerce was called off out of respect to the memory of the late Charles H. Purcell, Director of Public Works, who died suddenly in Sacramento on September 7th.

Official recording of the deeds for the bridges took place simultaneously by the California Pacific Title Company headquarters in Redwood City and by the Oakland Title and Insurance and Guarantee Company in Oakland, while at the same time in Sacramento Governor Warren handed over checks of $6,000,000 for the San Mateo-Hayward structure and $2,250,000 for the Dumbarton span.

Immediate result of state acquisition of the bridges was a reduction in tolls for automobiles from 50 cents to 35 cents on the San Mateo-Hayward Bridge and from 45 cents and 5 cents per passenger to 35 cents on the Dumbarton Bridge.

On September 11th in Los Angeles, Director of Public Works Frank B. Durkee had signed 8,350 bonds, representing the issue of $8,350,000 of revenue bonds authorized by the California Toll Bridge Authority for state purchase of the bridges. On August 15th, the authority had sold the bridge bonds to a syndicate headed by Blyth & Company of San Francisco and the First Boston Corporation, which took the 25-year bonds at an average interest rate of 2.3629 percent.

E. R. Higgins, Comptroller of the Department of Public Works, estimated that the bonds could be paid off

. . . Continued on page 57

Flag-raising ceremony on San Mateo-Hayward Bridge. Left to right, Toll Sergeant Harry V. Burke, Joshua Pyle, Toll Sergeant Chas. L. Smith.—Courtesy San Mateo Times.

Ramona Freeway

Report of Accomplishments In Los Angeles County

By P. O. HARDING, Assistant State Highway Engineer

The Ramona Freeway is the local name that has been given to the development of that portion of State Highway Route 26 extending from the City of Los Angeles to the City of Colton in San Bernardino County. This important east and west traffic artery west of Pomona has the unique distinction of carrying three U. S. highways designated by the numbers 60, 70 and 99. This fact indicates how vital a link the Ramona Freeway is in the U. S. Interregional Highway System.

The Ramona Freeway, when completed, will render all of the basic services that are required of highway transportation. It will be used for interstate travel to and from the southern and eastern states by way of Arizona. It will be the main connection between the Los Angeles Metropolitan Area and the Imperial Valley, directly serving agriculture and industry. It will also be extensively used by recreational traffic between the metropolitan area and the many scenic and resort centers in the mountains and deserts of Riverside, San Bernardino and Imperial Counties. Its most important use is for carrying the heavy morning and evening peak loads of commuter traffic characteristic of a large metropolitan area.

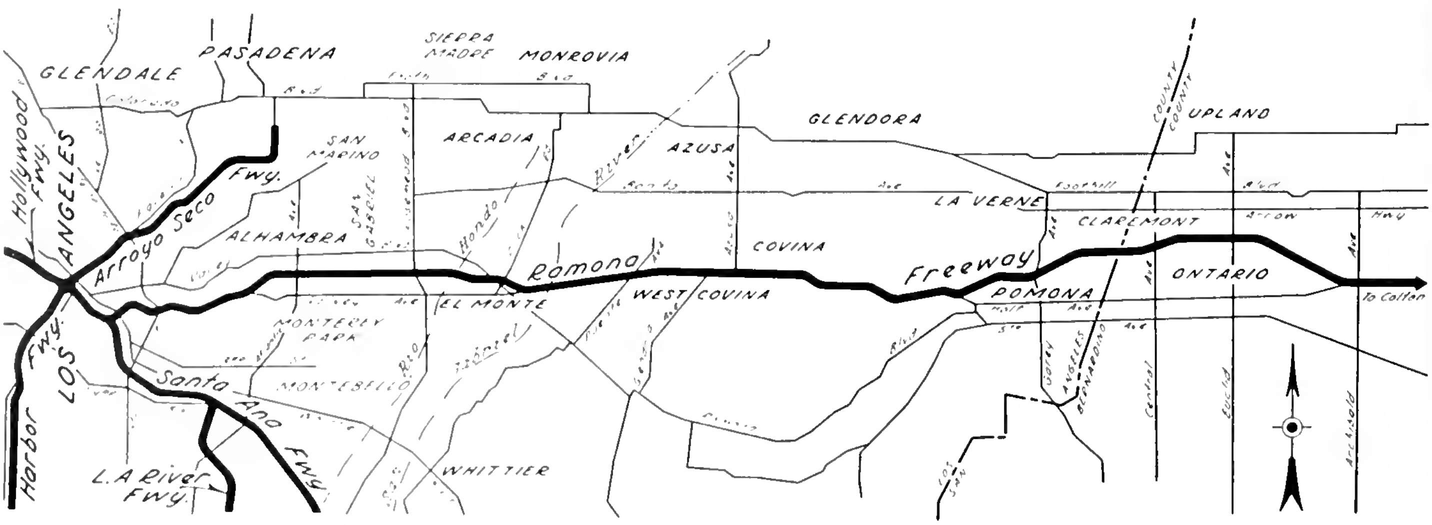
Major Arterial

Within Los Angeles County, the Ramona Freeway is the major east-west arterial through the San Gabriel Valley, directly connecting the rapidly expanding cities of Los Angeles, Alhambra, Monterey Park, El Monte, and West Covina with Pomona and Claremont. In addition to many important city streets and county roads, seven state highway routes (2, 4, 62, 77, 167, 168 and 170) will be intersected and at these locations grade separations and interchange ramp connections with the freeway will be provided. When completed, the freeway will also serve a number of communities not directly traversed, such as Pasadena, San Gabriel, Temple City, Arcadia, Monrovia, Baldwin Park, Puente, Covina and Glendora. Although the development of the San Gabriel Valley is predominantly residential, there is a corresponding expansion of local business areas and there is also considerable development of new industrial areas particularly along the main line Southern Pacific Railroad.

TRAFFIC STUDIES

Present average daily traffic volumes on the completed portion of the Ramona Freeway range from 37,000 at the junction with Santa Ana Freeway in Los Angeles to 42,000 at the east city limits of Los Angeles at Indiana Street. Peak flows on the freeway reach about 3,200 vehicles per hour in one direction at present, inbound in the morning and outbound in the evening. East of the City of Los Angeles, Garvey Avenue now carries a large part of the traffic which will move on the Ramona Freeway when it is completed. Garvey Avenue now has an average daily traffic of 29,000 at Atlantic Boulevard, 31,000 at Rosemead Boulevard, 24,000 east of Valley Boulevard, and 14,000 over the Kellogg Grade between West Covina and Pomona.

Traffic surveys indicate that Valley Boulevard and other routes more or less parallel to Garvey Avenue will also contribute substantially to the traffic expected on the Ramona Freeway, so that the 1951 average daily traffic which would be using the freeway if it were now available, is 26,000 at Atlantic Boulevard, 35,000 at Rosemead Boulevard, 45,000 east of Valley Boulevard, and 15,000 over the Kellogg Grade. The rapid rate of growth throughout this area will increase these figures each year.



UPPER—Looking easterly along Ramona Freeway showing the Eastern Avenue overcrossing which also spans the double-track Pacific Electric Railway. CENTER—Looking easterly showing completed Herbert Avenue overcrossing bridge. BOTTOM—Looking easterly showing Cornwell Street Bridge in foreground, the curving Pomeroy Avenue on ramp bridge and Marengo Street and Soto Street bridges in background.

Looking southerly along Rosemead Boulevard, showing recently completed construction for underpass with Pacific Electric Railway and Ramona Freeway

GENERAL LOCATION

The routing of the Ramona Freeway is shown on the accompanying index map. From the junction point with the Santa Ana Freeway at Aliso Street and Mission Road, the most logical and economical routing for the Ramona Freeway was along the tracks of the Pacific Electric Railway San Bernardino main line as far easterly as Rosemead Boulevard. From this point on easterly the location leaves the Pacific Electric Railway, and cutting southeasterly to Garvey Avenue, follows along Garvey Avenue through West Covina and easterly over the Kellogg Grade. After passing the Kellogg Grade, the location has been established northerly of Holt Avenue (existing State Highways Route 26) through Pomona and Claremont.

LOCATION THROUGH CITY OF POMONA

Studies and negotiations with city authorities regarding the location of the Ramona Freeway through Pomona were brought to a successful conclusion on May 16, 1950, when the Pomona city officials passed the necessary resolution authorizing Mayor Alan G. Orsborn to execute the freeway agreement with the State Division of Highways. The routing through the City of Pomona as finally agreed upon is considered as the ideal one for the best interests of the traveling public and also as the best possible routing to serve the present and the future requirements of the City of Pomona.

In reporting the brief ceremony held on May 19, 1950, upon the occasion of the visit of the California Highway Commission to Pomona, the *Pomona Progress Bulletin* stated in part as follows:

New Era of Progress

"The visit of the Highway Commission and other officials of the State of California to Pomona this morning marked not only a gesture of good will to the Pomona City Council, Pomona Chamber of Commerce and the community as a whole but the beginning of a new era of development and progress, according to the opinion of many who witnessed the informal but very significant ceremony.

"Each passing month will make more graphic the debt of gratitude which Pomona owes to the California State Highway Department. Already only three days after the signing of the freeway agreement the three-year economic coma which has held dormant the growth of Pomona is beginning to break. Plans for construction of new subdivisions and apartment houses are in preparation. Investment agencies are checking the territory. Three industries have reopened consideration of Pomona as a possible plant location city."

Since that time the American Brake Shoe Company and the Consolidated Vultee Aircraft Corporation have begun property acquisition and active construction for plants in the Pomona area.

LOCATION THROUGH EL MONTE

For a period of approximately twelve years studies have been in progress and negotiations under way with City of El Monte officials for the location of the Ramona Freeway through the City of El Monte. These studies involved a distance of approximately

four miles between Rosemead Boulevard and the San Gabriel River. On August 15th a public hearing relative to this matter was held in Los Angeles by the State Highway Commission. The commission, in its final deliberations, resolved the problem into a choice between two lines, the one designated "Line 4" as recommended by the State Division of Highways, and the other designated as "Line 7," a location straddling the Pacific Electric Railway tracks and calling for depressing both the freeway and the railroad, as advocated by the officials of the City of El Monte. All of the evidence developed by the State Division of Highways in the studies of the several routes through El Monte indicated the recommended Line 4 routing to be the most serviceable and economical for both through and local traffic.

The commission in adopting this routing issued a public statement to the effect that its conclusion had been rendered only after one of the most thorough investigations ever accorded a state highway routing and that the commission was satisfied that both state-wide traffic and local traffic will be best served by the adopted route. The commission further stated that it was prepared to budget funds to undertake right of way acquisition and ultimate construction as soon as freeway agreements may be made with the local governing bodies.

PREVIOUSLY COMPLETED CONSTRUCTION

The first items of construction to be completed in the development of the Ramona Freeway were the grade separation bridges for cross streets between Aliso Street and Indiana Street in Los Angeles City. Construction first started on these bridges during 1933. Road construction followed bridge construction, providing four 10-foot traffic lanes for a length of two miles. This pavement was completed and opened to traffic in 1935. In 1941 the State Division of Highways completed a construction contract widening the existing four-lane pavement to two 35-foot roadways with variable width median. The utility of this two-mile portion of the early Ramona Freeway was very greatly increased in August, 1944, when the City of Los Angeles completed its Aliso Street viaduct over Mission Road and the Los Angeles River, providing interchange connections with the Ramona Freeway. Later in 1947, a direct connection with the Santa Ana Freeway was made for the convenience of eastbound traffic when the first section of the Santa Ana Freeway was completed and opened to traffic from Aliso Street to Soto Street.

In 1949, a contract was let for a 1.8-mile extension from the Los Angeles City Limits in an easterly direction of the Ramona Freeway from Indiana Street to Helen Drive. This construction was completed April 20, 1951. As of the present time, 3.8 miles of construction on this freeway has been completed at a total cost of about $4,-000,000.

CONSTRUCTION NOW IN PROGRESS

On February 9, 1951, a contract was awarded to J. E. Haddock, of Pasadena, for the construction of a 1.5-mile easterly extension of the Ramona Freeway from Helen Drive to Hellman Avenue in the City of Alhambra. The estimated cost of this construction is $2,000,000. As of the present time, this contract is 30 percent completed. The estimated date of completion is November, 1952. There are four bridge structures included in this contract, one of which is the undercrossing for Fremont Avenue.

A contract for another very important unit of construction known as the Murphy Avenue connection, was awarded on May 31, 1951, to J. E. Haddock, of Pasadena. This contract includes the construction of a grade separation bridge under the Pacific Electric Railway tracks to provide full interchange between the freeway and Eastern Avenue which is a very important traffic artery serving industrial sections of the East Los Angeles area. The estimated cost of this construction is $200,000, the work is 30 percent completed and the estimated date of completion is July 23, 1952.

Looking easterly along completed Ramona Freeway at the east city limits of Los Angeles showing curving City Terrace on ramp bridge

$1,500,000 Contract

A contract was awarded on June 28, 1951, to the Griffith Company of Los Angeles, for a 0.9-mile length of the Ramona Freeway from Hellman Avenue to Eighth Street in Alhambra. This construction includes three bridges, one of which is the undercrossing and interchange. The estimated cost of this construction contract is $1,500,000. The estimated date for completion is March 23, 1953.

On September 6, 1951, bids were opened in the District VII office in Los Angeles for the construction of another unit 1.7 miles of the Ramona Freeway from Eighth Street in the City of Alhambra to Jackson Avenue, a short distance easterly of the Alhambra city limits. This contract includes the construction of four grade separation bridges at Sixth Street, Garfield Avenue, Almansor Avenue, and New Avenue. The Griffith Company of Los Angeles was the low bidder for this proposed construction, and the total of the contract items was $2,381,815.10.

At this time almost 100 percent completed and now ready for acceptance is the $855,000 contract of Vido Kovacevich Company that provides separation of grades with Rosemead Boulevard (State Route 168) passing under the Ramona Freeway and Pacific Electric tracks.

FUTURE CONSTRUCTION

Considering the 30.4 miles of the Ramona Freeway in Los Angeles County there has been spent and budgeted thereon for construction and right of way acquisition to date a total of about $18,000,000.

Plans have been completed and rights of way obtained so that an additional two-mile construction contract can be advertised and let in late 1951 to extend the Ramona Freeway from Jackson Avenue to Rosemead Boulevard. This will be the last of the construction on the Freeway that can be carried out with funds that have been budgeted for the 1951-52 Fiscal Year, and subsequent construction will have to wait until additional funds can be budgeted. In line with the current construction program, providing there are no serious delays due to restricted steel allocations, it is expected that we will have the six-lane Ramona Freeway completed in full, with all grade separations, interchanges and frontage roads, and opened to traffic for the entire 10 miles between the westerly junction with the Santa Ana Freeway at Aliso Street in Los Angeles and Rosemead Boulevard (State Highway Route 168) during 1953.

Looking westerly along completed Ramona Freeway, showing eastbound traffic under curving City Terrace Drive bridge

RECOMMEND LIGHTFOOT DRIVING

A light foot on the accelerator pedal will go a long way toward preventing engine knocks caused by the lower octane gasoline due to reach the Nation's service stations within the next few weeks, the California State Automobile Association advises.

A cut recently ordered by the National Production Authority in the amount of primary metallic lead that may be used in civilian motor fuel is responsible for the drop in the octane rating of gasoline.

Many automobiles, especially those with regular compression engines, will be bothered very little by the new gasoline because the octane rating of motor fuel, in normal times, is much higher than needed for the average passenger car anyway. Owners of automobiles with high compression engines, however, will be more likely to experience engine knocks.

New Link

Two Additional Miles of Hollywood Freeway Opened

By R. C. KENNEDY, Secretary, California Highway Commission

Tuesday, September 25, 1951, saw the official opening of another link of the Hollywood Freeway in Los Angeles.

Two miles of freeway, from Silver Lake Avenue to Western Avenue, were opened to traffic at 10.30 a.m. Immediately preceding the removal of the barriers, dedication ceremonies were held at the foot of the Santa Monica on-ramp under the direction of John B. Kingsley, President of the Hollywood Chamber of Commerce.

Kingsley opened his remarks by stating that inasmuch as Hollywood was one of the most important sections of Southern California it was only right and fitting that it have one of the most important freeways. He stressed the fact that this was to be a short and snappy dedication and speakers were to be limited to one minute.

The opening speaker was Lt. Governor Goodwin Knight, followed by Mayor Fletcher Bowron, Supervisor Roger Jessup, and Oscar Trippet, President of the Los Angeles Chamber of Commerce. Neil Petree represented the California State Chamber of Commerce on the speakers' list.

Assistant State Highway Engineer Harding speaks at dedication

Harding Gives Credit

Then came a number of rapid-fire introductions of prominent people who took a bow when their names were called.

Paul O. Harding, Assistant State Highway Engineer, in charge of District VII, was called on to speak and was given a little extra time by the master of ceremonies. Harding used all his time in telling the large crowd who of the city and state engineers had been instrumental in the completion of this portion of the highway. Harding ended his list by naming the different contractors and their representatives who were present.

Highway Commissioner Harrison R. Baker was introduced and extended his greetings to the public officials and the

State Highway Commissioner Harrison Baker and John Kingsley, Manager of Hollywood Chamber of Commerce, wielding the shears that cut the ribbon. In the picture to the left of Baker is Lieut. Governor Goodwin Knight and City Councilman Cronk, who is Chairman of the State, County and Federal Affairs Committee, and to the right of Kingsley is State Highway Commissioner James Guthrie.

officers of different civic organizations who were instrumental in developing the freeway program in Southern California.

Baker paid tribute to the late Director of Public Works Charles H. Purcell, for his part in the development of the State Highway System, and assured the audience that if Mr. Purcell were still with us he would be in attendance, as the completion of these freeways were very close to his heart.

Example of Cooperation

The commissioner stated that this section, although comparatively short, was forging another link in the chain of basic freeways in the Los Angeles metropolitan area; this section was linking together the Hollywood area with the Los Angeles civic center and the central business district. The welcome of the freeway into the boundaries of Hollywood was, he said, significant of the appreciation of local communities of the value of freeways as a community asset.

Baker called attention to the fact that this was an outstanding example of cooperation between the State of California and local public officials and civic organizations and he went on to name the different officials and civic organizations that were, and are, instrumental in the development of the freeway system.

MAYOR FLETCHER BOWRON OF LOS ANGELES

The speaker said that while the length of this section was but two miles, it had cost approximately $10,000,000 and that half of it was for right of way and half for construction. Attention also was called to the fact that 7.6 miles of the Hollywood Freeway were now open and in use and that the approximate length of the total project was about 10 miles.

The only uncompleted sections are from Western Avenue to Highland Avenue and from Grand Avenue to Spring Street in the civic center.

"There are 17 construction contracts now under way on the Hollywood Parkway, totaling $9,000,000," Baker said. "The next sections to be opened will be from Grand Avenue to Alameda Street, through the civic center, about December, 1951, and Western Avenue to Highland Avenue some time in 1953, depending a great deal on the steel situation."

He called attention to the fact that late in 1953 the completion date of the Hollywood Freeway would coincide very closely with the completion of the Harbor Parkway from the four-level structure to beyond Olympic Boulevard and the Santa Ana and Ramona Parkways from civic center to Rosemead Boulevard.

. . . *Continued on page 57*

View of completed Hollywood Freeway looking southerly from Santa Monica Boulevard, showing caravan using northbound roadway

In San Diego

Three Major Highway Contracts Now Are Nearing Completion

By J. F. JORGENSEN, Assistant District Engineer

THREE CONTRACTS on the Montgomery Freeway in the south bay area of San Diego have been completed and a fourth to cost $1,278,300 is well under way; grading and paving of a realigned section of U.S. 80 between the Willows and four miles east in San Diego County at a cost of $420,000 is nearing completion and a $370,000 steel girder bridge across Sweetwater River between Descanso and Alpine in southern San Diego County is approaching completion.

The Montgomery Freeway will connect Harbor Drive in National City with the Mexican Border, and the work now in progress will complete the facility as far as Palm City. This highway will become U. S. 101 upon completion.

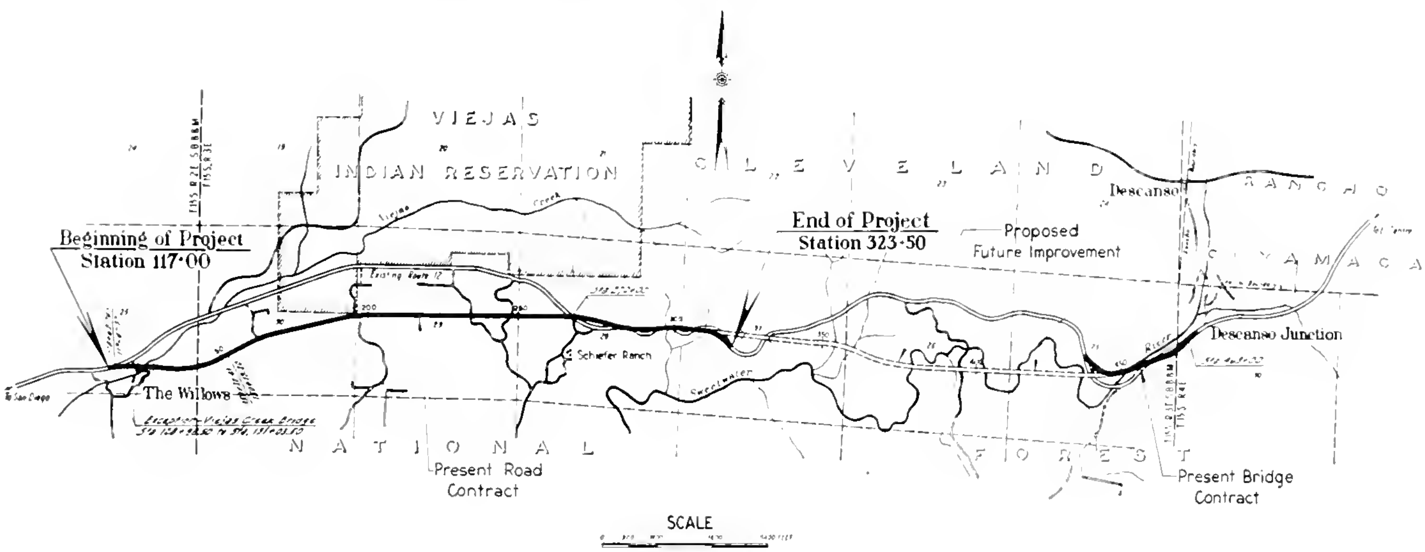
The first unit, between Seventh and 14th Streets, in National City, was completed in October, 1950. The second contract for construction of separation structures at H Street in Chula Vista and Main Street near Palm City was completed in April, 1951. The latest work completed on this freeway and now ready for acceptance by the Director of Public Works, extends from 14th Street in National City to G Street in Chula Vista. This project was discussed in the January, February, 1951, issue of *California Highways and Public Works.*

Separation Structures

All important crossings south of 13th Street in National City have been or will be made on separation structures. Frontage roads are being provided where necessary to serve local traffic. Multiple separation structures have been provided to separate local traffic from both freeway and railroad traffic at 18th and 24th Streets. At E and H Streets in Chula Vista, local cross-traffic passes over the freeway (which is de-

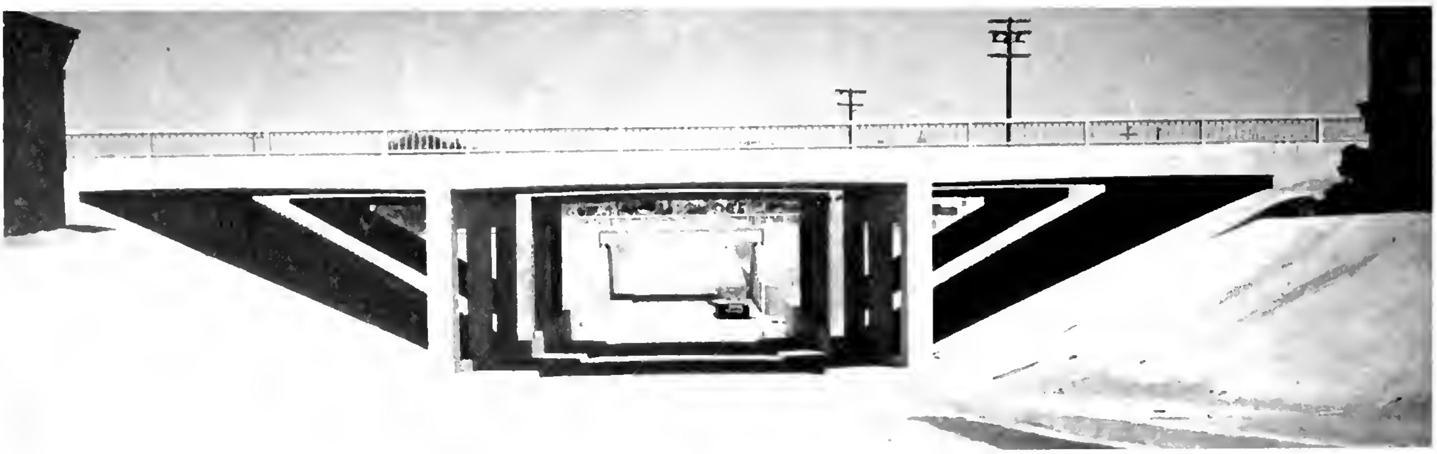
Main Street overcrossing under construction

In San Diego County, between The Willows and Descanso Junction



H Street overcrossing under construction

This is the completed 24th Street bridge



These are completed 18th Street bridges

pressed) on concrete separation structures.

At F Street a spur line of the S. D. & A. E. Railroad also crosses over the freeway. At Main Street a separation and interchange is provided for traffic entering and leaving the Otay area, in which are located several aggregate producers, with an accompanying heavy flow of commercial vehicles. At Palm Avenue in Palm City, near the southerly terminus of the present work, a three-level interchange is provided to accommodate heavy flows of traffic to and from the Coronado area in which are located the U. S. Naval Air Station and Amphibious Base.

Design of Project

All of the construction of this freeway is plant-mix surfacing on cement treated base, with sub-base of natural or processed select material, of varying thicknesses, depending on basement soil quality. An exception is at H Street where about 600 feet of portland cement concrete pavement on a four-inch thickness of cement treated base, supported by a pervious rock blanket, one foot thick, is being placed. This design is being employed at this location since ground water is within approximately two feet of profile grade where the roadway is depressed. It was determined that the rock blanket, together with a subdrainage system of rock and tile, would be more economical than the heavy "boat" section of reinforced concrete that is often necessary.

In addition to the major structures previously mentioned, twin bridges are provided at the Otay River and Otay Overflow Channel. Bridges were constructed on the new southbound or westerly lanes at the North and South Sweetwater Channels and structures on existing Bay Boulevard, which becomes the northbound lanes, were lengthened to provide adequate capacity for flood flows.

In constructing the new work unsuitable muck in varying depths up to eight feet was removed in the Sweetwater flats, and filled with select material. Check levels on subsidence in this area indicate that after nearly a year, subsidence is still in progress, although at a diminishing rate, the total maximum amount being, at this time, about 11 inches.

SUMMARY OF CONTRACTS

A summary of contract amounts for construction of this freeway, between Seventh Street in National City and Elm Avenue in Palm City follows:

Limits	Contractor	Const. Cost (Excl. Engr.)	Status
Seventh to 14th Sts., NatC	R. E. Hazard	$122,600	Completed
Structures at H and Main Sts.	Chas. MacClosky Co.	147,700	Completed
14th St., NatC to G St., ChV	MacClosky-Hazard & Willis	1,421,500	Completed
G St. to Elm Ave., Palm City	Griffith Co.	1,278,300	Under Construction

The work was supervised by W. T. Rhodes as Resident Engineer for District XI, and A. K. Gilbert and W. V. Cryderman as Resident Engineers for the Bridge Department.

U. S. 80 REALIGNMENT

Work on a 3.9 mile grading and paving contract in San Diego County between the Willows and four miles east is presently being completed by Clyde W. Wood and Sons. This project includes the realignment of a portion of the Viejas Grade on U. S. 80.

Principal improvements of this work over the existing road will be reduced total curvature, longer radius curves, flatter grades, and wider roadbed. Whereas the existing road has grade rates up to 7 percent and curves with radii as low as 300 feet, the new facility provides a maximum of 4 percent grades and minimum radii of 2,000 feet.

Grading operations were partially completed by convict labor at Prison Camp 40, but the camp was moved elsewhere before completion. The Wood contract provided for the completion of grading operations, some 263,000 cubic yards of rock and decomposed granite, as well as the construction of a 24-foot concrete pavement on a bituminous treated subgrade, with bituminous shoulders and other miscellaneous items of work.

Skew Joint Experiment

The subgrade treatment consisted of the application of approximately one gallon of SC-4 to the subgrade material and road mixing. As an experiment, on one-half mile of the work, the "dummy joint" strips of premoulded material in the pavement were placed on a skew of 2½ feet, in 12 feet. This skew joint was found to be no more difficult to place than the usual joint, and it is expected

. . . Continued on page 38

New alignment of U. S. 80 east of Alpine. Construction and paving operations.

BRUSH DISPOSAL

By A. A. MILLER
District Maintenance Engineer

SUBSEQUENT to the article on "Vegetation Control" in the March-April, 1950, issue of *California Highways and Public Works*, District I has supplemented the heavy-duty brush cutter with a brush chopper to facilitate the disposal of brush removal.

The brush chopper, which consists of a special planer head revolving at approximately 4,000 r.p.m. is powered with a fifty-horsepower gasoline motor. The speed at which the planer head revolves is sufficient to make it self-feeding, and at the same time discharge the chips and shavings for a distance of from 20 to 30 feet.

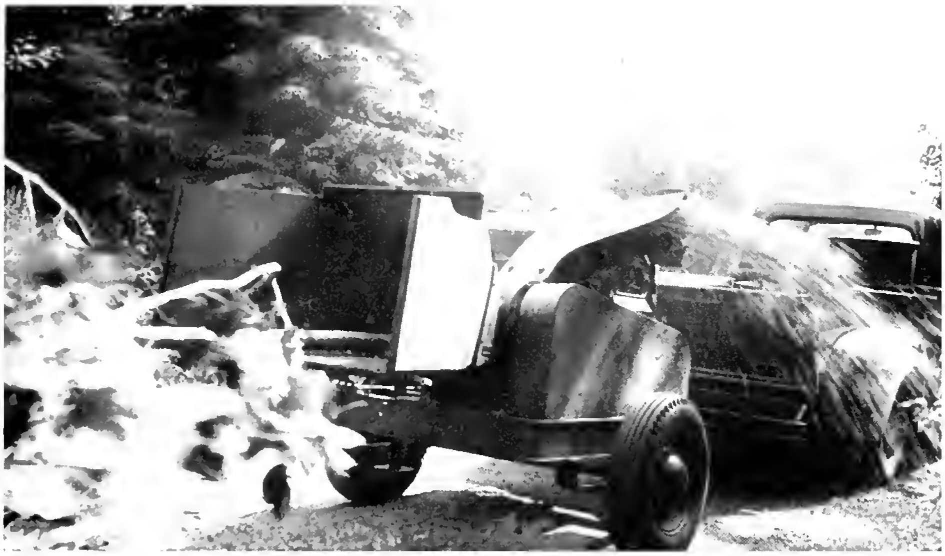
The machine is capable of disposing of brush and trees up to six inches in diameter as fast as two men can throw the material into the hopper. The hopper is so designed that it is almost impossible for a man to have his fingers come in contact with the planer blades, as the distance from the edge of the hopper to the planer blade is considerably more than the average mans' reach.

The chopper is mounted on a two-wheel trailer normally pulled by a pickup truck, which travels at variable speed, depending upon the amount of brush to be disposed of.

The chopper has been used to a considerable extent in the State Parks in Humboldt County, and local park officials have no objections to the resultant chips and shavings being discharged on the cut slopes. In the event the machine was being used in an area where such disposal was objectionable, the chute may be extended and the material discharged into a truck.

UPPER Side view of brush chopper attached to truck. CENTER Rear view of chopper. BOTTOM - Feeding trees into chopper.

The chopper has decreased the cost of brush removal over the previous method of loading on trucks and hauling to a disposal site. It has been estimated by the district tree foreman that he now disposes of the same amount of brush with the same crew in one day which previously required four days.



UPPER—Chopper drawing brush into hopper.

CENTER—Chopped material being expelled.

BOTTOM—Chips and shavings after expulsion.

The operating and maintenance cost of this piece of equipment is not high, requiring only the necessary gasoline and oil required for the 50-horsepower motor and resharpening the four planer blades once a week, which costs approximately three dollars a set.

1

2

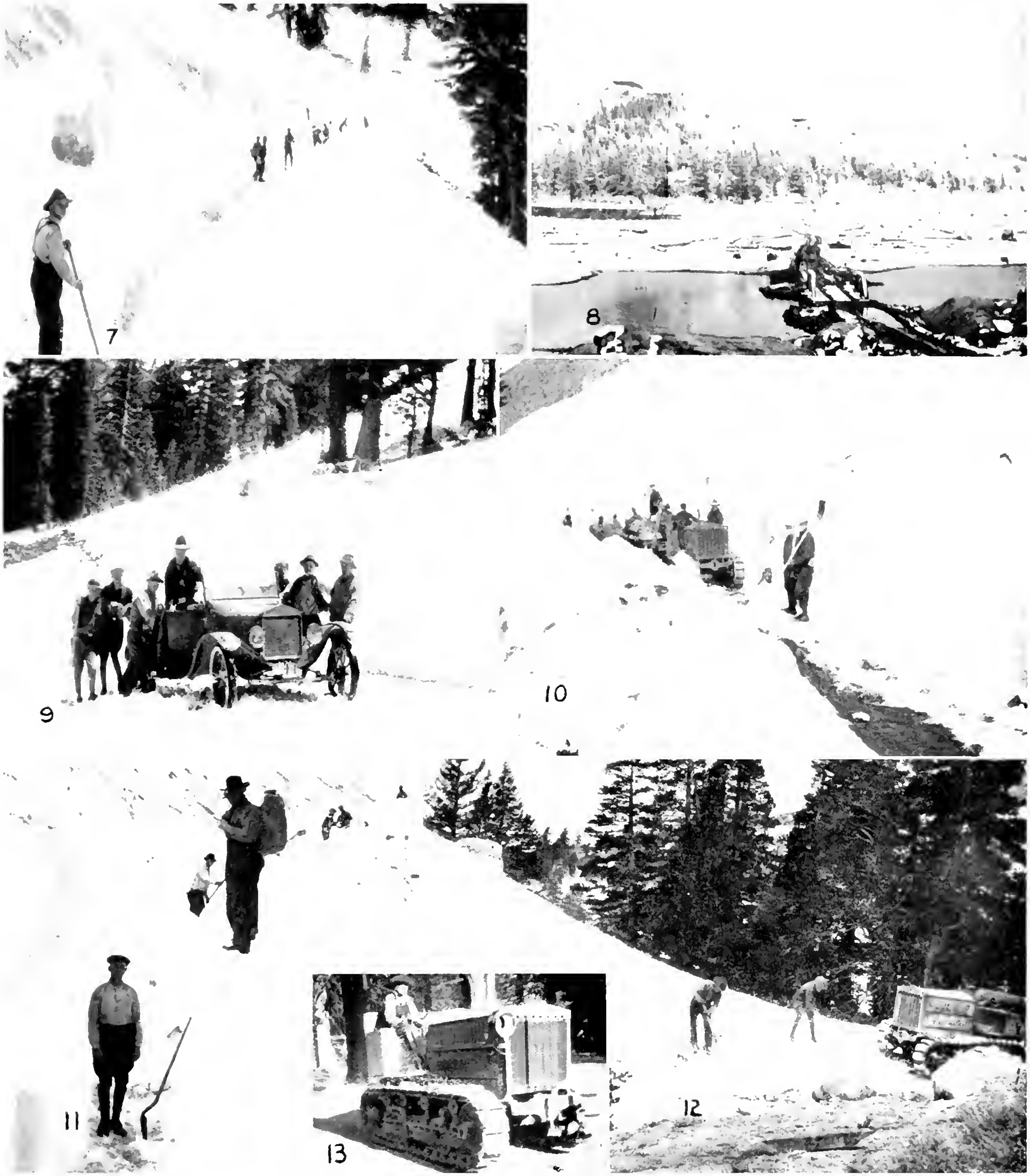
3

4

5

6

Every time Tom Healy, Sacramento businessman sees a rotary snowplow or snogo in action he is reminded of the days he and a construction crew cleared snow off Sign Route 88 and Red Lake Grade in Alpine County with hand shovels. These photos are from Mr. Healy's Album. (1) Construction crew on Red Lake grade, Sign Route 88, in the summer of 1923, left to right, O. P. Brown, now Sheriff of Alpine County; Dick, the cook, fireman, shovel runner; Tom Brown, Gustofferson, shovel operator; Bill Giffin, Harry Slater, Lew Sackett, Tom



Healy, Bill Martindale. (2) Top of Twin Lakes Dam. (3) Power shovel used on project. (4) Summit of Carson Pass. (5) This Model T had rough going during construction. (6) Looking toward Twin Lakes from Kit Carson Pass. (7) Clearing snowdrift on Red Lake Grade June 24, 1923. (8) Old Twin Lakes bridge now at bottom of lake. (9) First automobile over road, close to Kit Carson Pass. (10) Opening of road on June 26, 1925, on Red Lake Grade. (11, 12) Clearing roadway with hand shovels. (13) Tom Healy operates tractor on job.

Headquarters Shop

Parts Department Expands To Meet Requirements

By EARL E. SORENSON, Equipment Engineer, and
JAMES A. FOLLINE, Machine Parts Storekeeper, Grade II

HEADQUARTERS Equipment Department of the Division of Highways operates a Parts Department at each of its shops, as an important function of its activities. The one at Headquarters Shop has recently been moved into larger quarters, and is now being reorganized along modern lines.

The expanding operations of the Equipment Department have been reflected in a demand for additional floor space for each subdepartment including administrative, accounting, service, stores, and the several shops. The truck repair shop has been moved into a newly completed structure of 12,261 square feet floor space. The administrative structure has been enlarged by 2,800 square feet. Several other shops have been relatively enlarged.

The expansion, over a period of time, of the numerous shop repair facilities, resulted in compressing the Parts Department from an original area of 4,420 square feet, into an area of 2,100 square feet. These expansions in turn were reflected in a demand for a greater volume of materials and supplies from the stores. As the Parts Department area was utilized "to the ceiling," it was necessary to spread out "all over the lot." This was neither efficient nor economical for the over-all function of Headquarters Shop as a whole unit.

Department Modernized

To bring the Parts Department into line with the other departments, it was moved to a covered area of 8,400 square feet, entirely separate but centrally located between the old shop and new truck shop buildings. Many improvements were installed in the new area. Equipment, materials, and supplies were transferred to new bins, shelves and racks. A modern Parts Department office enclosure of 400 square feet was provided.

After providing adequate quarters for the Parts Department, additional functions were instigated, accounting procedures were mechanized, and personnel increased. In order to better illustrate the growth of the Parts Department and its increase in space and personnel it would be well to remember that for June, 1941, the stock on hand at Headquarters was valued at $31,877, whereas June, 1951, showed a total valuation of $260,441. For the whole state-wide Equipment Department the materials and supplies inventory has increased from $153,700 in June, 1941, to $750,923 in June, 1951.

Growth of Stock Items

There has also been continued growth in the types of items carried in stock. At the present time there are 84 stock cards for new tires alone. These tires range in size from 3.00 x 7", 2-ply, costing $2.41 each, to 14.00 x 20" tires, 14-ply, costing $192 each. A few examples of the items carried in stock, showing the wide variance in values and types, are listed below:

Fan shaft for Snogo	$43.26	each
Joint cork seal for 1949-1950 Ford V-8	.015	each
Shaft 11T for Caterpillar tractor	30.90	each
Chrome Moly. steel, 2-inch square	.1153	lb.
Electrical tachometer and flexible shaft	109.00	each
Lacquer	1.50	qt.

Next it was found that though we had much more floor space, our increased activity demanded that it be most efficiently utilized. To accomplish this, the old storage bins are being reconstructed into more efficient and modern shapes. To these changes, 19 Rotabins, two cabinets, one 90-drawer small parts cabinet, 1 rotary drill cabinet, and a 16-section bulk rotary bin have been added. To these will be added eight 3-deck tire racks, 10 feet high and 15 feet 6 inches long, which will provide 372 lineal feet of tire storage space. These tire racks were designed by the Parts Department and are under construction at this time.

Increased Demand

To supply the increased demand for materials and supplies, it was necessary to order and maintain much larger quantities of individual items which require larger individual storage spaces. This in turn meant storing items further from the issue window and causing undue delay in servicing requests. To overcome this disadvantage rotary bins and cabinets have been installed close to the issue window and only a week's supply, or less, of all fast-moving items have been "binned" within 20 feet of the service window. This represents better than 90 percent of the fast-moving stock items and supplies, and effects great economy in time for issuing.

Each bin is located by a bin number, which is recorded on the stock records. Most of these "token bins" have a much larger "over-stock" bin further back from the service area. These "over-stock" bins, in turn are located, numbered, and noted on the "token bin" tags. This cross-numbering provides a simple and fast means of replenishing any "token bin" in short supply.

Items Grouped

Because the number of individual items was becoming so great and the resulting number of stock cards and volume of paper work increasing proportionately, it was necessary to group items of like kind and of equal value, to minimize the detail work. Items of small value or items issued in measurements of less than a standard unit are purchased against a permanent job number and designated as "miscellaneous small purchases" (M. S. P.). Once a month the accumulated value in this job number is cleared by credit and

Interior of Parts Department dispensing stockroom, Headquarters Shop, Sacramento

debited in one lump sum to "stock" on a card designated as "MSP." This eliminates a large volume of detailed posting on the stock card. This "MSP" stock is disbursed by the issue window clerks, at an equitable rate that maintains a controlled value of $2,500 to $3,000 in this account. Steel, bronze, spark plugs, etc., more or less of equal grade, shape, or value, are likewise grouped and disbursed in set units of measurement and value.

Keeping Records

The department was also confronted with the problem of keeping adequate records to properly control operations down to the smallest item. After a thorough study, it was decided to install rotary card files, each capable of filing over 6,000 stock record cards. This type of rotary filing wheel takes up a minimum of space, is easily operated, and makes a maximum number of records cards available to the operator with the least amount of effort. Two of these filing wheels have been installed at Headquarters Shop Parts Department. One wheel is handled by the issue window clerks. This stock record system involves the use of two different stock record cards, each type of card having two colors—buff and salmon. The buff cards denote the item is to be charged for, and the salmon cards denote the article to be "MSP" or no-charge. This color scheme has been adapted for use throughout the records and stock bin tags.

Permanent Master Record

Another wheel will be kept in the Parts Department Office to carry a permanent master record. These cards are designed to record by coded description, location, unit of measure, model, application, cross index of application, amounts received, issued, and balance, amount ordered, requisition number, date, purchase order number, vendor's name, and amounts received. In addition, these cards are designed to cover specifications, minimum and maximum stock to be carried, amounts and units of purchase, references and other essential information. These cards are as near a complete Parts Department record as can be set up on one card and they also eliminate the "want book" and "local request" form. Specification standards, to be used for reordering, will also be carried on these cards. It will then be a simple matter to compile a complete and accurate requisition with items separated as to like kind and designated Purchasing

Equipment Department constructed five racks for storage of tire inventories

Department buyers. They will, in effect, be a complete catalog of parts and materials carried in stock and of maintenance supplies regularly purchased. Anyone knowing the classification or name of any given item can immediately ascertain its location, vendor, price, technical description or any other information desired.

New Forms Created

Several additional records have been designed to expedite Parts Department operations. Form 106 has been created to expedite the taking of inventory and is used in the bookkeeping machines the same as Whiz Register Form S-104, to immediately adjust any discrepancies. A materials tracer postal card with three copies has been placed in use—original, vendor; duplicate, purchasing division; triplicate, storekeeper; quadruplicate, schedule clerk. These tracer cards are made up as one-time carbon snap-out forms. They are mailed out once each week and have proven very successful in expediting deliveries. Other changes in procedure and record forms are now under consideration.

A change in the method of storing and handling steel has been instituted. Storage racks have been installed, under cover, with overhead trolley chain lifts to facilitate handling of the steel. All requisitions for steel are filled in sizes cut to exact measurement. To accomplish this a metal-cutting band saw running in fluid cutting compound has been installed. Steel handling when expedited in this manner requires the time of only one Parts Department employee permanently assignd to this operation.

New Equipment Records

Receiving, checking, and transferring of new equipment is handled by two members of the Parts Department staff. Forms S-57, S-157 "Equipment Check Sheets" and Form S-82, "Equipment Data Card" have been revised to more readily record the many details in modern equipment. These revisions have been so designed that the sequence of recorded information will be the same on each form. It is the Parts Department responsibility to see that each transfer of rental equipment to a district shop superintendent be accompanied with accurate check sheet, data card, and other necessary documents. This will eliminate or cut to a minimum the time necessary for the district shops to receive new equipment on transfers. This operation is handled by two members of the Parts Department staff who also receive, handle, and disburse tires, oils and fuels.

A service station with one permanent attendant is maintained by the Parts Department. The usual services are rendered and a monthly average of 6,500 gallons of gasoline is dispensed.

. . . Continued on page 55

Maintenance

Highways Are Not Good Highways Without It

By C. F. WOODIN, Supervising Highway Engineer, Maintenance

It is the intention of this brief discussion to reverse the famous radio quiz program by providing 20 answers to the query: "What does the Maintenance Department of the Division of Highways do?"

Before presenting the direct answers, it is proposed to comment on some of the factors providing serious problems to the organization in the fulfillment of its operations.

Referring to the chart in *Fig. 1*, a ready comparison may be made between the California Highway Cost Index (see also *California Highways and Public Works*, March-April, 1951), and annual maintenance expenditures during the decade, 1940 to 1950. It will be noted that maintenance expenditures increased at a much lesser rate than the cost index in spite of the fact that:

1. The average wage increased from \$146 per month in 1941 to \$303 in 1950,
2. Equipment rentals have likewise increased appreciably,
3. A large portion of the field forces has reached an average age of 45 or better.

Some Factors

Although *Fig. 2* shows a reduction in field personnel from 3,495 in 1941 to 2,384 in 1950, the average monthly pay rolls for the same years aggregated \$510,000 and \$715,000, respectively.

Other factors which place a strain on the physical and financial resources of the maintenance organization include (1) the doubling of traffic lanes and right of way acreage when existing highways are transformed through reconstruction from 2-lane rural roads into 4-lane divided freeways; (2) the increase in landscaped areas; and (3) the widespread installation of traffic signals and intersection illumination made necessary by the extraordinary upsurge of traffic since World War II.

To meet the conditions described, it has been necessary to expand to a greater degree the use of equipment or to substitute methods which more exclusively utilize various types of equipment. This planned revision in procedure is reflected in the results illustrated in *Figs. 1 and 2*.

Now, what does this organization do? What are the activities which contribute most toward the expenditure of more than \$20,000,000 annually? The following answers are necessarily brief but it is hoped that they may furnish a clearer perception of the scope and versatility of this close-knit section of the Division of Highways.

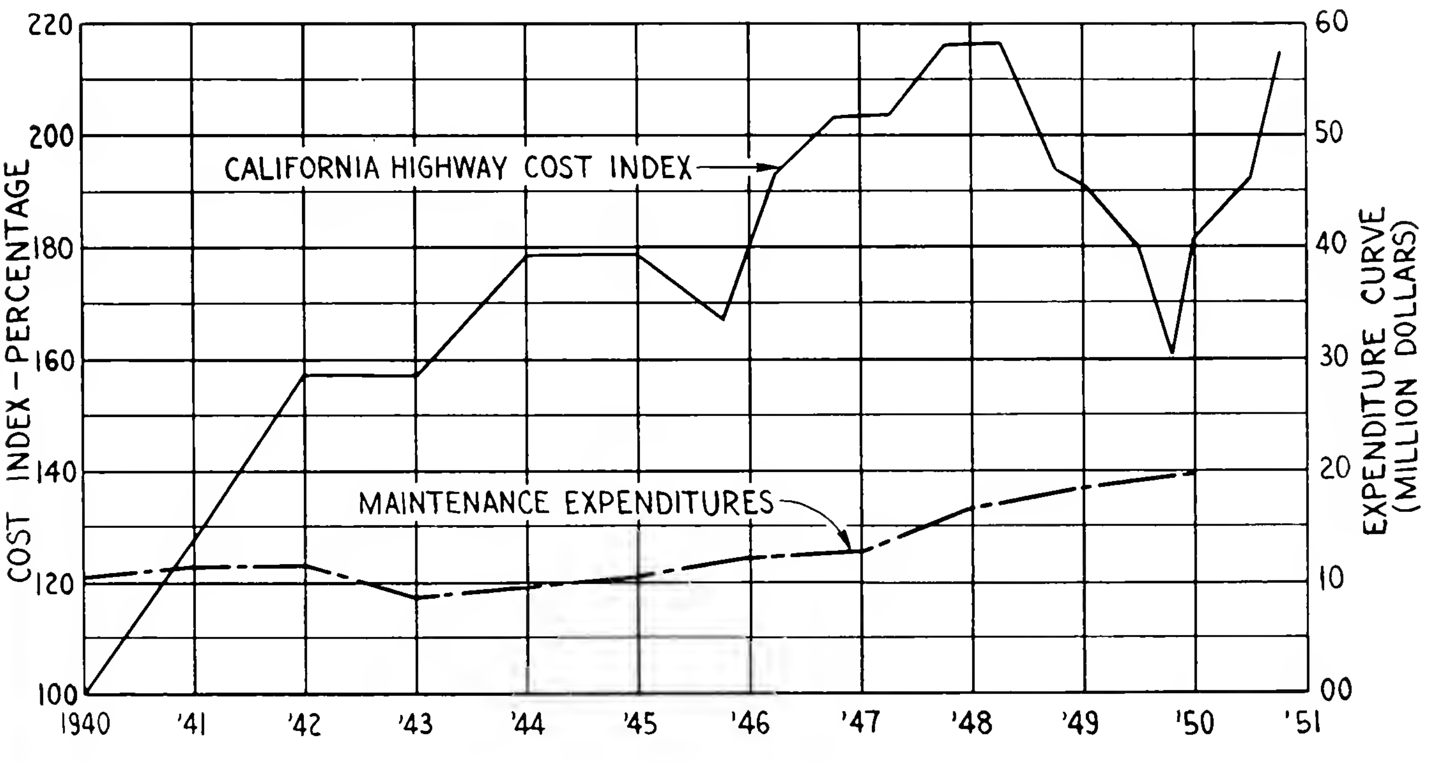


FIGURE 1

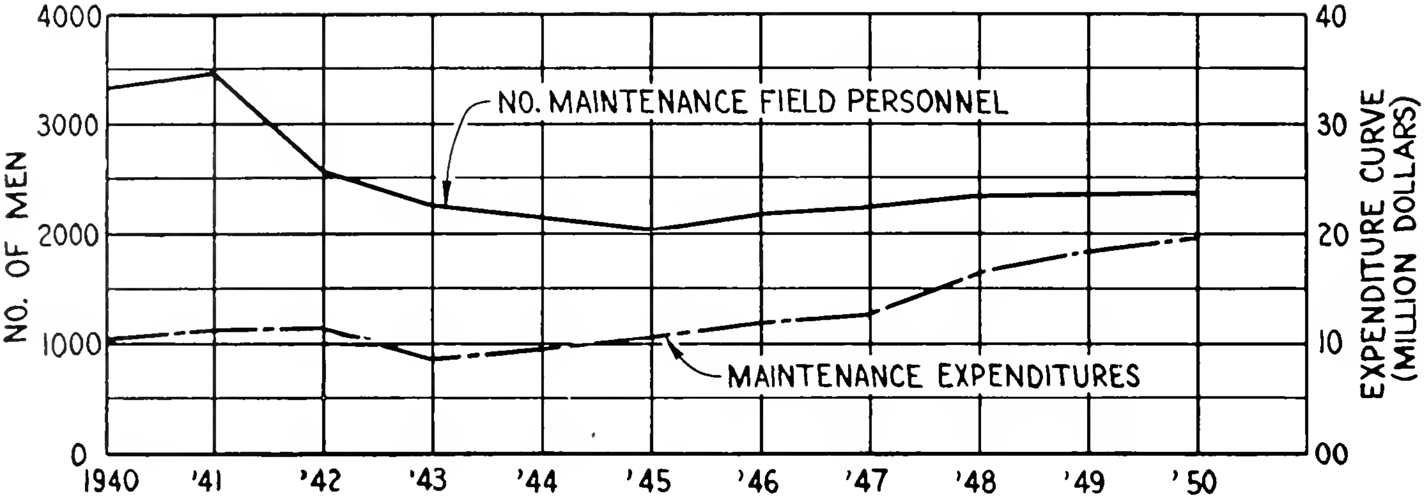


FIGURE 2

Rotary plows dispose of snow remaining after heavy push-plow operations

SNOW REMOVAL AND DRIFT CONTROL

For the romantic and adventurous, this phase of maintenance operation has particular appeal. To them, snow is associated with beautiful scenery in a calm, quiet setting where the young can toboggan and ski and the oldster can contemplate the view. In the removal of snow the picture changes in aspect. First, it is a 24-hour job. Second, the work must proceed whether in blizzard or sunshine, daylight or dark. And last, the job must continue until the road is reasonably traversable and traffic has resumed its normal progress.

However, in spite of the rugged demands made upon the crews assigned to this activity, there is a spirit of enthusiasm in their work that is difficult to match in any other maintenance endeavor. In the bunkhouse between shifts, stories of current incidents are swapped and the succeeding crews report to their assignments with added fervor.

Drift control is a dry weather activity. Permeable type fences are located to the windward after careful study of prevailing wind directions and winter drifting conditions. At many locations, the drift fence is the economical factor determining whether the road can be kept open continuously with the available snow removal equipment.

Snow removal, sanding icy pavements and drift control cost $868,000 during the 1950-51 Fiscal Year. This and all other cost figures shown hereinafter do not include general expense items which are pro-rated as a final accounting procedure.

STORM DAMAGE REPAIR

The past winter has furnished spectacular examples of storm damage amounting in the aggregate to approximately $4,-300,000, and for which $670,000 was expended from maintenance funds. In addition, these funds furnished $1,676,000 to cover the cost of ordinary slide and storm damage repair, which figure is in excess of the previous year's expenditure for like repair by $378,000.

Notable among the instances of unusually heavy damage was the All-year Highway in the Merced Canyon between Briceburg and the Yosemite National Park boundary. A contract has been recently let for the repair and restoration of the highway and the placement of slope protection along this 18-mile stretch at a cost in excess of $1,200,000. Prior to this, in order to carry traffic safely through the affected area, maintenance forces spent some $42,000 constructing detours around two washouts, shifting the road into the bank at narrowed sections, placing stone rip rap protection at vulnerable spots, and installing the usual signs, lights and barriers for traffic safety.

Other similar damage occurred along the Smith River in Del Norte County, in the Kern River Canyon east of Bakersfield, and along the East Walker, Truckee, Carson and Yuba Rivers in the Sierras.

Emergency replacement and protection at washout on U. S. 40 east of Truckee last winter. First consideration is for the safety and resumption of traffic.

EROSION CONTROL

Erosion control is linked very closely with storm damage repair and in some instances may be identical. It may involve the repair or extension of existing installations or the placement of new units. Repairs or extensions are not necessarily made in kind. Sack concrete rip rap is very adaptable for this purpose and is an economical type wherever an abundant supply of suitable creek- or bank-run gravel is available. Recently failed seawalls which had served for many years were replaced or reinforced with extra heavy stone rip rap. With the continued disintegration of the seawalls, it is expected that similar repairs will be required in the near future.

Erosion occurring from rainwater falling or flowing on fill or cut slopes has been effectively reduced with artificially established vegetative ground cover combined with straw, wire mesh or brush layers. The greatest vulnerability of this type of protection occurs during storms before the plantings have become sufficiently established. Repairs may consist of the replenishment of eroded soil and plantings or, in the case of fill slopes not in view of the road, a gravel blanket or backfill may be used to replace eroded areas or to stabilize the entire slope.

SLIDE PREVENTION AND CORRECTION

It can generally be stated that the cause of most slides is the presence of water within the slide mass. Any practical and economical means of intercepting and removing that water before it has saturated or lubricated the potential slide, should prevent future slippage. However, such procedure is not always practical and unless the earth mass is too large, unloading the slide at the top and intercepting surface water from the slide area has been successful.

At larger locations, exploratory vertical borings are made to determine the location of the water-bearing strata. Benching of the slide area and the driving of horizontal drains to tap the water wherever it may be found are frequently combined as a corrective method. Smaller slides are sometimes supported and retained at the road level

with crib bulkheads or may be removed entirely to the slippage plane. Slipouts—those slides which are entirely below the roadway—most seriously interfere with traffic. Usual treatment consists of complete or partial removal to the slippage plane, installing subsurface drainage and backfilling with a material less susceptible to slipping. Some slopes slump through saturation of the earth either from surface water, subsurface water or from the rise and fall of an adjacent stream. Lateral support by means of cribbing is the usual remedy for this condition.

TRAFFIC STRIPING

Some 11,500 miles of state highways are striped at a cost of over $600,000. Glass beads are applied to improve night visibility and, in addition, to increase the service life of the stripe. Considerable research continues with various lacquer ingredients in an effort to eliminate those materials which are imported and in short supply or unavailable during periods of emergency.

Striping is applied by special crews in each district using machines designed by the Equipment Department. The striping machines are highly automatic and when once adjusted will place a single, double or triple line either continuously or dashed as conditions may require. The machine also applies the glass beads simultaneously with the traffic lacquer.

In some districts, depending on the organizational set-up, pavement markings such as pedestrian crossings, "Stop" or "RR Xing" signs may be applied by the district-wide striping crew or by others assigned within a superintendent's territory.

REPAIR OF BRIDGES AND STRUCTURES

The Bridge Department has assigned several engineers to make periodic inspection of state bridges. Their reports provide a statement of condition and recommend the need of any repairs or improvement. On the basis of the recommendations, the necessary work is done either by contract or state forces. Bridge maintenance costs were approximately $650,000, of which $345,000 was expended for bridge painting.

Movable span bridges entail additional expense due to their operation requirements. With the exception of the Petaluma Creek bridges, they are located principally over the lower Sacramento and San Joaquin Rivers and in the delta region above the confluence of these two major streams. Two ferries operate near Rio Vista.

About 50 operators are required for both bridges and ferries and the cost of operation amounted to $250,000 for the 1950-51 Fiscal Year.

Incessant hammering by the ocean and other natural forces require vigilance and ability to cope with such problems as this

PAVEMENT REPAIR

The usual popular conception considers highway maintenance to be confined principally to patching pavements. It should be noted that although it is an important function of the Maintenance Department, there are other operations which, in the aggregate, occupy a larger portion of the field crews' time and effort.

Pavement repair includes several suboperations such as patching small failed areas with bituminous-mixed material, restoring base and surface in isolated areas, scarifying and remixing bituminous surfaces and placing seal coats or plant-mixed blanket courses of limited thickness.

Over $3,600,000 was spent during the 1950 oiling season in the resurfacing, reprocessing and seal-coating of both pavement and improved shoulders. This figure does not include the patching and repair accomplished as ordinary maintenance procedure.

SUBSEALING

This is a relatively recent development in the treatment of concrete pavements. Displacement at the joints, called "faulting," is a result of the loss of subgrade material through the pumping action of heavy loads traversing the pavement during wet weather.

First experiments in California were conducted in 1944 and 1945 and consisted of forcing low penetration asphalt beneath the pavement to fill the void formed by the loss of material. Such good results were obtained that the treatment has been continued until now there have been expended over one and one-quarter million dollars for the purpose. Exclusive of the work done under construction, subsealing work during the past year cost in excess of $161,000.

PAVEMENT JOINT AND CRACKFILLER

This operation has been in force for many years, its principal object being to exclude surface water from entering the subgrade through the joints or cracks. At first, low penetration air-blown asphalts were used but because they became very brittle in cold weather and lost their adhesive qualities, they were blended with a slow-curing material with somewhat improved results. However, the softer blends, although adequate at low temperatures, tended to run out of the joints during the summer and were lost.

The harder blends were equally unsatisfactory in winter.

Through research and experimentation in cooperation with the Testing Laboratory, there has now been developed an asphaltic latex emulsion which when handled according to specifications has given very promising results, although it is yet too early to determine its service life. Further development has been made in cleaning and preparing the joints for filling. There is now in general use a mechanical pavement joint cleaner, power-driven, to remove the old oxidized filler and insure a better bond between the pavement and the new material.

STATE PARKS

Provision has been made in the Streets and Highways Code (Section 186) to maintain highways in state parks. Bridges are inspected and maintained as for state highways and general maintenance of the main public roads, excluding parking and camping areas, is performed as required. Improvement work is done under service agreements issued by the Division of Beaches and Parks.

SIGNS

The maintenance of warning, directional and informational signs requires the full time of 20 men equipped with 17 trucks having bodies especially designed for this work. These crews also make installations of new signs on construction projects. The annual cost of maintaining signs approximates $200,000.

SIGNALS AND ILLUMINATION

There are 1908 signalized intersections on state highways throughout the State. Of this number 921 are maintained by the State, the remaining 987 being maintained by a few of the larger cities for which the State is billed for its pro rata share based on the number of entering roads which are a part of the state system. The maintenance of the 921 signals operated by the State requires the services of 45 men. In the two metropolitan areas, Los Angeles and San Francisco, highly specialized crews are on call on a 24-hour basis. Intersection illumination has expanded appreciably and requires constant maintenance in their operation. The annual cost of maintaining signals and lighting amounts to approximately $380,000.

RADIO COMMUNICATION

Radio initially was limited particularly to the snow routes, U. S. 40 over Donner Pass and the Pacific Highway (U. S. 99) north of Redding. Later, it was expanded to the northeasterly portion of Modoc County and east of the Sierras in Mono and Inyo Counties. The next expansion was to include the San Bernardino Mountain area and the Ridge Route in Kern and Los Angeles Counties. Installations are now in progress for the remaining districts in the State.

Combination loading and breaking equipment picks up and pulverizes hardened bituminous pavement in the process of remixing and stabilizing

Road information reports are published each work day during the winter and early spring and are available to all automobile clubs and key radio broadcasting stations or wherever the dissemination of such information will benefit the traveling public.

MISCELLANEOUS TRAFFIC PROTECTION AND SAFETY

When emergencies arise, quick and accurate decisions are in order. An extraordinary slide, a flooded roadway or a washout can be a disaster or a minor incident depending on the dispatch with which the maintenance personnel places warning signs, barricades and flagmen. Delay in establishment of detours may cause a traffic jam which may take hours to disentangle. In this regard, the Maintenance Department are proud of their record and the men who made that record possible. With the more extensive use of radio, such situations should and will be met with greater dispatch.

TREES AND LANDSCAPING

With the rapid development of urban freeways and the resultant increase in landscaped areas from 1946 to 1951, the crews required to handle this specialized phase of maintenance have experienced a 200 percent expansion from 68 to a total of 203 men over the same period. The watering, pruning and general upkeep expense cannot be avoided if a desirable standard of appearance is to be preserved. The annual maintenance cost of this phase of operation has now reached $930,000.

FIRE HAZARD CONTROL

The spraying and burning of roadside vegetation to provide a firebreak has been an annual program, with portions of the work being done cooperatively with various counties, the State Division of Forestry and the U. S. Forest Service.

Several methods are in use to prevent the spread of fires originating in the highway area. Spraying a strip between the roadway and the right of way line with a light application of diesel oil while the vegetation is still immature and later burning the deadened growth before adjacent vegetation has developed to the inflammable stage is one of

the earliest methods and is still being used with success. Depending on climatic and local conditions, chemicals such as sodium or other chlorates are used for their sterilizing effect. This treatment is of particular value around guard rails, bridges and sign- and guideposts. Mechanical methods by discing, blading, mowing or early burning each have their peculiar advantage under certain favorable conditions. Approximately $192,000 was the Division of Highways' share of the cost of this work for the year ended June 30, 1951.

PERMITS

Legal limitations are defined in various state codes as to use of the highways. These include dimensions and weights of vehicles and loads, the routes upon which excess loads may not operate, the placing of signs within or adjacent to a highway, the planting or injuring of any vegetative growth within the right of way, and the establishment of openings or other encroachments within a highway. Under certain conditions, the limitations may be modified through the issuance of a permit after due consideration has been given to the protection of highway traffic and to the highway itself.

For the Fiscal Year 1950-1951, over 55,000 permits were issued, with nearly one-half issued in the Los Angeles and San Francisco areas.

EQUIPMENT COORDINATION

In order to secure the optimum use of state-owned equipment, a coordinator has been assigned in the larger districts. His work is especially valuable during the busy summer months, when the oiling program activities must be scheduled in order to utilize the limited available equipment to its greatest capacity. This operation has been instrumental in reducing costs and increasing efficiency.

RESEARCH AND SPECIAL INVESTIGATIONS

Without research and studies of special problems, little progress or improvement could be made. Involved in this activity through the years have been joint-filling and traffic stripe material studies, as well as methods of pavement repair and slide prevention. Additives in bituminous materials to increase their resistance to stripping,

By increasing capacity of asphalt heating unit, subsealing can be done by two nozzlemen simultaneously

subsealing materials and methods, and erosion control have also been subjects of special study.

In 1937-38, special investigations in connection with the heavy flood damage of that winter were made in cooperation with the Design, Construction and Bridge Departments. A manual, "California Culvert Practice," was the result of cooperative study with the same departments. Participation in a joint research, investigation and study of bank protection, shore protection and erosion control is now in progress with the publishing of a manual covering the design and construction of bank protection installations as its principal objective.

STATE HIGHWAYS IN CITIES

Since January 1, 1948, the maintenance of state routes through cities has been a responsibility of the Division of Highways. If a city is properly organized to handle various phases of the work, such work is delegated to them through a special agreement. In general, the larger cities are equipped to handle complete routine operations while in the smaller cities, the assignment consists mainly of cleaning and sweeping.

Maintenance funds were expended for the 1950-51 Fiscal Year as follows:

Work done by cities	$1,527,567
Work done by State	1,514,669
Total	$3,042,236

Outdoor advertising, the foster child of the Maintenance Department, is self-supporting through license and permit fees which are required for each advertising sign placed in rural areas under the Outdoor Advertising Act. Among other restrictions, advertising signs may not be placed or worded so as to confuse highway traffic, obstruct the view at curves or intersections, nor are they permitted to direct traffic or to simulate an official sign or signal.

Because of their distribution throughout the State, maintenance men and their families are a composite part of their respective communities. Their participation in service clubs, P. T. A.'s and other community betterment projects helps to promote good public relations. During pavement operations or emergencies, the maintenance man's first consideration is the care of traffic with a minimum of delay. The flagman courteously answers questions, informs the traveler why the delay is necessary and cautions him as to the hazardous conditions which might be ahead. Further public contact occurs through the maintenance superintendents and foremen in their daily routine, whether it be with adjoining property owner asking for a drainage improvement or requesting a permit for the paving of his driveway.

The result of these contacts influences greatly the opinion that the general public forms concerning the Division of Highways in particular and the State Government in general. The over-all result in this regard has been gratifying.

Mountain Road

City Creek Highway in San Bernardino Officially Opened

Completed by stage construction of five units costing a total of $3,900,400, the 15-mile City Creek Highway connecting the City of San Bernardino with mountain recreational areas officially was opened to traffic for its entire length on August 19th.

A two-day celebration marked the occasion and attracted 8,000 persons. Dedicatory ceremonies were held at Running Springs, where Lieutenant Governor Goodwin J. Knight officiated at a ribbon-cutting.

New City Creek Highway is a far cry from the original City Creek Toll Road, built for only $52,000 in 1891 as an access road by the Highland Lumber Co. The county, under an act by the State Legislature, bought the road in 1903 and widened it with the aid of prison labor. It was not until 1935 that the State took it over as part of the State Highway System and designated it as Route 207.

Describing the celebration at Running Springs, Lew Barrett, writing in the San Bernardino *Daily Sun*, said:

"City Creek Highway, officially opened to the public at Running Springs yesterday, was cited by Lieutenant Governor Goodwin J. Knight as one of the reasons why 300,000 Southern California residents make vacation trips every summer month to San Bernardino Mountains.

"The elaborate ceremony climaxed a two-day celebration at Running Springs which attracted 8,000 persons for Saturday night's show featuring Ina Ray Hutton, Dan Dailey and Geraldine Mapes.

"Following the ribbon cutting at 11.45 a.m., the Acting Governor of California, his guests, Members of the California Highway Commission and 2,000 spectators attended a western barbecue and vaudeville show.

"Lieutenant Governor Knight congratulated members of the county board of supervisors, Sheriff Eugene L. Mueller and members of the mountain community for their efforts to get the freeway completed. He said:

Beautiful Highway

" 'It is a beautiful highway connecting San Bernardino Valley to the vacation land of pines, clear blue sky, no fog, no smog, and such highways as these are the reasons why many thousands are planning to come to your mountains this summer and why 300,000 every month have visited them in the past.'

"Two members of the highway commission were honored guests. They were James A. Guthrie, editor and president of the Sun Co., and Harrison R. Baker of Pasadena. Mr. Guthrie thanked the Acting Governor for his kind words and then said:

" 'This highway climaxes 20 years of hard work and it represents one-fifth of all the state funds spent on highways in San Bernardino County since the close of World War II, or $3,900,000.'

Tribute Paid

"Mr. Baker paid tribute to Mr. Guthrie and other fellow members of the Highway Commission for their efforts which brought about California's excellent highway system.

"Others who spoke words of greeting and congratulation were State Senator James E. Cunningham, Sheriff Mueller, District Attorney Lowell E. Lathrop, H. George Cunningham, supervisor; S. W. Lowden, district engineer, and Ted Meyers, radio announcer who served as master of ceremonies.

"In his invocation, the Rev. Fr. Michael O'Duignan, pastor of the Lake

. . . Continued on page 52

Highway Opened—Lieut. Governor Goodwin J. Knight snips ribbon to officially open City Creek Freeway to the public at Running Springs. Left to right are State Senator James E. Cunningham, James A. Guthrie, Highway Commissioner and Editor and President of The Sun Co.; Lieut. Governor Knight, Harrison R. Baker, Member of the Highway Commission, and Lloyd Soutar, Running Springs businessman, who was chairman of the celebration.

HIGHWAY DESIGN AND THE BUSINESS COMMUNITY

This paper was delivered by E. T. Telford, Engineer of Design, Division of Highways, at the 22d annual meeting of the Institute of Traffic Engineers, a national organization, in Los Angeles, September 23-27. It is recommended reading for all employees of the Division of Highways and for all civic groups and individuals who are interested and concerned with our highway problem.

In any approach to the problem of the relation between highways and the business community, one of the first things to define is the business community. All too frequently the highway engineer finds himself involved in a serious design problem which involves a small concentration of retail business. A repetition of these problems leads to the impression that the business community is a thing apart, a special case as it were of specialized local interest represented by owners of motels, service stations and retail businesses.

Look at Broad Picture

If we will stand back a reasonable distance from our immediate problems and look at the broad picture, we find that the business community includes *production* in the form of agriculture, mining, lumbering, manufacturing, etc, *distribution*, both wholesale and retail, including the super-market or the corner grocery where your wife buys coffee and other items of your breakfast. We have also the miscellaneous field of news, entertainment, travel, etc., as well as the business of administration including the financial fields of banking and all the related fields which go into this business community All are mutually supported parts of the whole economy and are tied together by the business of transportation and communications. Communications might be termed the transportation of ideas and information. Of course, we have the business of government, local, state, and national, with its civil and military operations and responsibilities. It, too, functions effectively to the extent that transportation and communications in all their forms operate freely and adequately.

Importance of Highways

The importance of highways to the business community has been recognized by the action of legislative bodies at all levels in providing funds for highways and legal basis for organization to handle administration of those funds to provide the facilities demanded by traffic.

Our particular task is that of providing a safe, smooth and comfortable path for operation of motor vehicles engaged in the transportation of persons and goods. The purpose of this transportation is as varied as the lives of the individuals concerned, from an afternoon shopping tour to the transcontinental movement of heavy freight.

The professional responsibility of the highway engineer includes not only the administration of existing highways but the continued development of new and better ideas and the translation of these ideas into safer and stronger highways.

Congested Traffic

Highways wear out due to increased loads, and the passage of time. They also become obsolete and lose their usefulness when local roadside development reduces traffic capacity.

During the past years of increasing traffic congestion, engineers and administrators sought for some remedy for the creeping paralysis which transformed a high speed, relatively safe newly constructed traffic artery into a congested business street with a slow moving mixture of local and through traffic fighting for passage or parking.

This led to the idea of controlled access with separation of conflicting traffic movements. This idea was put into effect under various names, as parkway, expressway, freeway, etc., in various parts of the country, and in 1939 California gave legal sanction to the freeway idea. This was followed in 1947 by the Collier-Burns Act which provided additional funds, thus making possible an effective start on the actual modernization of portions of the State Highway System.

Milestone in Design

These two legislative acts are milestones in highway design in the State of California. They provide in the first case a basis of legal authority for the California Highway Commission to declare a state highway a freeway and in the second the money to at least make a start on the job that faces us.

Today the highway engineer is called upon to prepare plans that will guide the transformation of vast sums of tax money into roads which will provide for rapid, safe, and convenient movement of motor vehicles in numbers and at speeds unheard of a few years ago.

The people using these vehicles are footing the bill through various motor vehicle taxes. They are the customers we in the highway business serve directly.

Purposes of Highway

To serve these people we must design a highway which will:

(1) Gather and Distribute Local Traffic. Here we provide direct contact between business and transportation. This is the origin and the destination of traffic, the farm, the mine, the factory, the store or office. Without these, there would be no traffic.

(2) Provide a Safe Roadway to Destination. This involves all the factors of alignment, grade and sight distance, together with width of roadway and quality of pavement, which together provide for safe operation at reasonable speeds for the volume of traffic which may be expected to use the road. Detailed requirements will vary with the density of traffic, the terrain traversed, and the type of service contemplated, that is, a local road, a major arterial, or a freeway. Under this heading of safety comes, of course, the matter of separation of conflicting traffic movements. We have found that on heavily traveled routes, intersections at grade are the source of a very high percentage of accidents and that under some conditions traffic control devices such as channelization, signals, lighting, etc., are not effective in reducing that accident rate. Conditions such as these can only be remedied as funds become available and in the interim it appears that only vigorous enforcement of restricted speeds can reduce the accident rate.

(3) The Highway Should Retain Its Capacity to Handle Traffic. In the past we have had many examples of well-designed and well-constructed highways which rapidly lost their capacity to handle traffic due to the development of local business along the highway. These highways were constructed for the purpose of handling through traffic and while the abutting property undoubtedly benefited to some extent the motorist who paid the bill found that he had invested in a highway which did not serve him. Consequently, from his standpoint this represented a definite loss in our highway investment. On the other hand, we have the example of the Arroyo Seco Freeway which, due to its freeway characteristics, has retained its capacity to handle traffic and for that reason may be regarded as an excellent investment of highway funds. I believe it is safe to state that in our experience to date our only regrets in design are due to those few cases where for one reason or another design standards were reduced and consequently service to traffic and the business community is not as good as we now design for.

Lack of Understanding

In the past few years the specialized field of small town and roadside business has been most critical of the designer. Much of this criticism has stemmed from a mutual lack of understanding.

The small town or roadside businessman could see the reason for a freeway when he wanted to get through some other town but not in his own community. The designer with his head ringing from the verbal assaults of a vociferous minority frequently felt that the entire community was against him and compromised his design to secure agreement from the objectors. This generally added some hazard and frequently the objectors were the first to complain about the result.

Effect of Freeways

The strenuous objections voiced by representatives of many business communities led the Division of Highways to make studies of the actual effect of freeway development on local business. This has been carried on by a Land Economics Section in the Headquarters Office of the Right of Way Department of the Division of Highways. These studies have thoroughly supported the conclusion that freeways do not destroy real estate or business values. As a matter of interest and information, I have appended to this talk a tabulation of certain information compiled in the course of this study. The data supporting this and all of the conclusions of the Land Economics Section are available to interested parties in the Headquarters Office of the Division of Highways.

Community Asset

All of this simply points up the fact that a properly designed freeway is a community asset despite the fact that during the period of construction some painful readjustments may be necessary.

The highway engineer charged with the responsibility of design has all of this background of experience and general information available to him but before any highway can be designed there is certain specific information which the traffic engineer must furnish. The importance of the varied details of this information will depend upon the volume and type of traffic to be served, the location and class of the highway.

The questions the designer will ask of you, the traffic engineer, will cover a very large field but in general they will be:

Traffic density;
Classification of traffic;
Origin and destination of traffic;
Turning movements;
Accidents, including rates, points of high accident occurrence, type and general cause of accidents;
Special local problems.

Design Policy

Before the highway engineer can make the necessary basic decisions on design policy, he must have from you some reasonably accurate estimate of the traffic situation as covered by the above items. He is not concerned with hair-splitting refinements in the forecast of traffic movements but he must know the seriousness of the present traffic congestion and accident rate and certainly some realistic estimate of the daily and peak hour volume of traffic he is to serve, together with the desired origin and destination in sufficient detail to enable him to provide for it. The more reliable this information is the better will be our ultimate design.

The designer and the traffic engineer should jointly observe their completed handiwork. In recent years many designs were obsolete in some respects by the time they were constructed but worked surprisingly well. A few others have not worked so well. If we study the principles involved and endeavor to learn the primary reason for any deficiencies or failures to properly serve the traffic, we will probably improve the quality of our future work. In this the traffic engineer and the design engineer must work very closely and both must maintain close contact with other highway departments and with the local community in order that a more complete understanding of our mutual problems may be had.

Conclusions

In conclusion I wish to emphasize the following points:

(1) The business community includes the entire economy of the Nation.

(2) It is tied together by communication and transportation.

(3) Adequate highways are an absolute essential to the motor transportation of persons and goods.

(4) Our ability to design and construct continually better highways has brought about increased traffic demand with consequent increased cost and revenue.

(5) This increase in traffic has made freeways essential in order that large volumes of traffic may be moved rapidly and safely, separated from the conflict with local movements.

(6) The designer needs information. Much of that information must come from the traffic engineer.

(7) We must work for a more widespread understanding of the varied problems of moving traffic. To accomplish this we must work closely not only within our engineering group but with those concerned in the operation of vehicles and the enforcement of traffic laws.

Land Economics Section Accomplishments During 1950-51 Fiscal Year

During the past year the Land Economics Section completed the first phase of its studies dealing with the effects of freeway by-passes on real estate values and retail business condi-

. . . Continued on page 49

In San Diego

Continued from page 21 . . .

to result in a smoother riding job since wheels of a vehicle will not cross the joint simultaneously, as with the conventional joint.

Future plans provide for extension of this new work easterly towards Descanso Junction on entirely new alignment to join the new crossing over the Sweetwater River. Right of way for the entire work has been acquired on a limited access basis.

Contract amount for the project now under way is $420,000. The contract is being supervised by Leo G. Cline, Resident Engineer.

Bridge Project

Another project in this area, well on the way towards completion is for the construction of a steel girder bridge, and approaches, across the Sweetwater River in the vicinity of Descanso Junction, at a cost of $370,000.

This project, also being constructed by Clyde W. Wood & Sons, will replace the existing narrow bridge which has sharp curvature at the approaches, inadequate sight distances and insufficient superelevation. The old structure has been the scene of many serious accidents.

. . . Continued on page 62

Bridge construction across Sweetwater River east of Alpine. UPPER Erecting steel girders. LOWER Looking up at steel superstructure.

AN EXAMPLE OF THE DEVELOPMENT OF A TEST METHOD AND ITS PRACTICAL CONSEQUENCES

By W. E. HASKELL, Associate Materials and Research Engineer

The following article by Mr. W. E. Haskell of the Materials and Research Department, Division of Highways, is intended as a description of a laboratory development, i.e., to illustrate a process rather than to impart new information. The technical aspects of the particular development have been well covered many times in previous papers and reports.

—Editor

ENGINEERS who specalize in the study of structural materials must be able to adopt, discover or develop small-scale or laboratory tests that are directly and quantitatively related to the performance of the materials in actual structures. Such test methods are not always easy to devise, since the need for simplicity and economy must also be considered; as complicated procedures and expensive equipment invariably limit the number of tests that can be performed. When, on occasion, a simple and inexpensive test method is contrived, its applicability and usefulness is often found to be astonishingly large, and may constitute a point of departure for exploration into unknown territory.

Special Test Methods

The records of the Materials and Research Department of the California Division of Highways cover the development of many such special test methods. It is the purpose of this paper to describe an excellent example of how such a method was discovered, how it was found to "tie in" with field observations, how it was proved to be a specific test for a specific thing and how it made, and is still making, valuable contributions to Portland cement and concrete technology. Much of this subject matter has appeared in the technical journals but it is believed that the general facts will be of interest to those who are less familiar with research or its particular vocabulary but who do use our highways and contribute to their support.

The example is part of a research project conducted by Thomas E. Stanton, formerly Materials and Research Engineer of the California Division of Highways and his co-workers, and has come to be known as the cement alkali-aggregate reaction, for reasons which will appear at a later stage.

Research Initiated

This research was initiated some years ago as a result of several failures in concrete structures and highways located in Southern California, all of which failures were characterized by the excessive expansion and map cracking of the Portland cement concrete. A search for the causes was complicated by the observation that in some prior cases, the same concrete aggregates which were used in the failed concrete had functioned satisfactorily. Also prior to the work of the California Division of Highways, the affected structures had been examined by other authorities and their condition had led to various theories, presumptions, and conclusions which were not always in agreement and which were, in most cases, unsupported by sufficient factual data.

When the problem was passed to the Materials and Research Department, it was evident that the first steps toward a solution would have to be:

(1) The discovery of a way to reproduce the expansion and map cracking in the laboratory.

(2) To make such a method quantitative if possible.

(3) To do it economically.

Test Specimens

In order to comply with item (3) it was decided to make test specimens in the form of small bars which could be accurately measured for expansion and to submit them to such treatment as might be typical of field conditions. This treatment consisted of exposure to the air of the laboratory, soaking in water, and alternate wetting and drying cycles, since these are some of the conditions to which structures are subjected. The bars were fabricated of Portland cement-sand mortar using a number of sands with both good and poor service records and with all of the California cements together with some sands and cements from out-of-state localities. Some of the wet mortars were also molded into small 2-inch by 4-inch tin cans which were sealed and stored away for future observation.

After some months of exposure, it was found that the problem of duplicating the phenomena observed in the field was not so easy as it had appeared to be. The small bar test specimens with "the innate cussedness peculiar to inanimate objects" refused to expand or crack in the manner expected of them, regardless of their composition or condition of exposure. Fortunately, however, it was observed upon stripping one of the 2-inch by 4-inch mortar cylinders that "the specimen * * * was covered with blotches fringed with a white efflorescence * * * and in a short time the entire specimen became covered with cracks * * *."

"It was apparent that when test specimens were kept in sealed containers or at least protected from the atmosphere and any drying out but at the same time prevented from any leaching of salts from constant immersion or from alternate wetting and drying, a chemical reaction was going on which caused an excessive expansion of the mortar with ultimate failure."

Significant Discovery

This more or less fortuitous discovery was of course significant but it did not mean the solution of the problem by any means. It did, however, sug-

gest that the small bar specimens might be induced to duplicate field behavior if they were stored in ordinary covered or sealed vessels containing only a small amount of water. This almost ridiculously simple but *hitherto unthought-of procedure* was to prove exceedingly fruitful as will be seen in the following paragraphs.

When submitted to these new storage conditions, a series of measurements and visual observations now brought to light three additional and important facts.

(1) That some of the test bars till refused to crack or to expand to an appreciable extent.

(2) That some mortar bars made with certain sands would expand and crack with some cements but not with others, and that the magnitude and rate of expansion differed among the several sands and cements.

(3) That this behavior was similar to the observed condition of certain structures and pavements.

Tentative Hypothesis

These findings were sufficient to justify a tentative hypothesis to the effect that a chemical reaction was taking place between one or more of the components of some of the cements, and one or more of the components of some of the sands.

Here again a highly significant discovery was made as a direct result of the simple laboratory method of storing test specimens in sealed containers with a small amount of water. It was, moreover, a quantitative method since magnitudes and rates of expansion could be measured and differentiated. However, it was still not a complete answer to the problem.

Some of the more obscure factors were cleared up by applying the methods of chemistry and petrography.

For some time a suspicion had existed that the alkalis of the cement (that is, the sodium and potassium oxides which are present to a greater or lesser degree in all cements) might be the offending component of the cement, and all of the cements used in the tests had been chemically analyzed. Notwithstanding the fact that these alkalis are present in very small amounts, generally less than 1 percent, it was found that the bar specimens which had expanded and cracked were invariably those in which a high alkali cement had been used. Furthermore, a chemical analysis of the exuding gel-like efflorescence from actual structures had showed it to be an impure sodium and potassium silicate almost certainly formed by the interaction of the cement alkalis with some form of silica present in the sand portion of the mixture.

Petragrapher Examination

An examination of the sands by the petrographer revealed that the sands in the affected mortar bars contained grains of chert, shale or a peculiar siliceous magnesian limestone of Miocene age, and more particularly that these rock fragments contained the mineral opal, which is an amorphous silica and which was known to be somewhat soluble in alkali solutions with the formation of alkali silicates.

As heretofore noted, a large number of sands had by this time been tested with both high and low alkali cements and an extensive background of data had been accumulated. The source of the shales, cherts and limestones had been traced from the river gravels to deposits in the surrounding mountains and samples of these materials collected. Synthetic mixtures of these rocks had been made up and tested and the results when translated into terms of larger units indicated that in some cases it was perfectly possible that a concrete mixture weighing about 4,200 pounds per cubic yard could show a deleterious expansion if the cement component contained as little as six or seven pounds of the alkalis and the aggregate contained 30 or 40 pounds of the reactive sand particles.

Alkali Limitation

Quantitatively, it had been found with reasonable certainty that cements low in alkali (less than 0.6 percent) would in all probability prove to be satisfactory for use with reactive aggregates and hence it was reasonable to place an alkali limitation on all cements which were to be used with reactive aggregates. This was done and the results up to the present time have proved to be satisfactory.

The publication of these findings by Mr. Stanton in the technical press gave further impetus to the work of other agencies who had also attacked the problem and the sealed container test was adopted by all of them. The work of the California Division of Highways was abundantly verified and in a short time many other facts and some theories were placed in the literature. One of the oddest of these facts is the principle of the "pessimum" * amount which was reported by Mr. Stanton in another paper. The word "pessimum" was coined by him in describing a fact which is paradoxical in the extreme.

Reactive and Nonreactive Material

In nontechnical terms, it means that an aggregate may be so bad that it is good; that if it contains enough reactive material it then becomes *nonreactive* with respect to expansion and cracking. If the aggregate contains more or less than a certain "pessimum" amount of reactive particles, the expansion will *decrease* in proportion to the excess or deficiency over or under the "pessimum" amount. The expansion may be practically nil when the reactive material is present; perhaps to the extent of 70 to 100 percent and the "pessimum" amount may be determined by test to be as low as 5 or 10 percent.

It is actually and demonstrably possible to take a *mildly* reactive sand and render it *strongly* reactive by diluting with a *nonreactive* sand.

Inhibitive Properties

The term "pessimum" may also be applied to the grain size of the reactive particles. In general, the smaller size fractions are the most reactive until a rather fine state of subdivision is reached when another interesting and paradoxical phenomena occurs. As an example, a reactive aggregate containing about 5 percent of a certain opaline chert when submitted to the sealed container test will expand and crack in a relatively short time when a high alkali cement is also used.

If, however, about 10 percent of the cement is replaced by the same amount of the same shale which has been ground to a fine powder, the expansion and cracking are definitely inhibited thus attesting the truth of the old adage about the "hair of the dog that

* Meaning the reverse of optimum as there is no favorable connotation in the sense used.

bit you." This inhibitive property is not confined to opaline cherts alone but is a characteristic of several other rocks and minerals when properly prepared. These materials belong to a class that are known as "pozzolans."

Answers to Tests

It is now readily apparent that the discavery of the simple sealed container test method was a very essential step in solving a major problem and that the answers were:

(1) A chemical reaction takes place between the alkalis of Portland cement and certain aggregate constituents.

(2) That this constituent in observed cases was certainly the mineral opal.

(3) That the reaction causes expansion and cracking in a concrete structure or pavement when the amount of alkalis in the cement are sufficiently great and when the opaline rock particles are present in a quantity approximating the "pessimum" amount.

(4) That high alkali cements can be used without danger with nonreactive aggregates.

(5) That cements with less than 0.6 percent of alkali are generally safe to use even with reactive aggregates.

Confirmations

The simplicity of this test and its relatively minor cost had also enabled the laboratory to assemble such a mass of actual test data that the findings were virtually indisputable and the publication of the method permitted any interested party to make such tests themselves. Indeed, one of the first confirmations of the Division of Highways results was given by a cement manufacturing company whose product was normally high in alkali. Needless to say, confirmations of this kind were very gratifying.

All of the California cement manufacturers soon devised operating procedures whereby they were able to produce low alkali cement when necessary and also without prohibitive expense. With respect to the sand and gravel producers, the answer was equally agreeable since it did not rule out the use of their material which was otherwise satisfactory, but did indicate a way to avoid failure in future work.

Cost of Tests Small

Since the test method was on a small scale, simple and easy to follow, and permitted a large volume of work to be done with a minimum of labor, the cost of the project was small in comparison with the cost of restoring faulty pavements or questionable structures.

It has been noted that the publication of Mr. Stanton's first paper, and then of several others on this subject, had assisted many other agencies and individuals in carrying on work along the same lines. Many of them were in the United States but a considerable number were in foreign countries. The California Division of Highways was also continuing the work and among them all, other facts speedily emerged. In enumerating the investigators, chronological order and priority of publication will not be attempted but an incomplete list would include:

Cement manufacturers
Sand and gravel producers
Universities and colleges
U. S. Bureau of Reclamation
U. S. Army Engineers
Portland Cement Association
State highway departments
Bureau of Public Roads
National Bureau of Standards

and many other individuals and agencies.

Extensive Investigations

A large proportion of the investigators used the sealed container test at some point in their investigations.

In addition to the opaline shales, cherts, and limestones, other rocks were found to be reactive. All of them were identified and included certain glassy acidic igneous rocks and a metamorphic rock called phyllite.

Extensive investigations were also made on the use of the finely ground materials called "pozzolans" mentioned in a previous paragraph. These materials in addition to being inhibitors, display other useful properties when used in certain types of construction.

An extensive series of tests on commercial aggregates from many areas in the State of California were made and their reactive properties determined. Other agencies conducted similar tests in other states.

Sealed Container Test

A short and useful chemical test for reactivity was developed by the research workers of the U. S. Bureau of Reclamation who used as a comparison our old friend the sealed container test. In an excellent paper, they pointed out that their test requires less elapsed time to obtain an answer than does the sealed container test, but some investigators express doubt as to its certainty in borderline cases. It is not to be inferred that the sealed container test is perfect or infallible and this chemical test may in time supersede it.

Two theories with respect to the mechanism involved in causing cracking were advanced by W. C. Hansen in the U. S. and by H. E. Vivien in Australia.

Many Investigations

The foregoing paragraphs do not include all of the work that has been done with the aid of that useful tool, the sealed container test. A recent bibliography of the papers on the subject of chemical reactions of aggregates requires 12 pages to list titles and authors alone. Sufficient has, however, been said to make the point that a good and simple laboratory test may open the way to many developments and also to other perplexing situations

At the time of the discovery of this test method, agencies other than the California Division of Highways were also working on the same problem and it is possible that the same or some other equally useful test method would have eventually been discovered by one or more of them although the second possibility seems to be small

It is clear that circumstances or good fortune were favorable when the cracking was observed in the small cylindrical specimen (fortune oftentimes does reward the observing), but the development of the method and the subsequent conclusions were entirely a rational and scientific piece of research in which analysis, synthesis and intuition all played a part.

It is an excellent example of how a new tool may assist in finding the answer to a serious and practical problem involving substantial amounts of money, and at the same time contributes to the erection of a rather imposing structure of scientific fact.

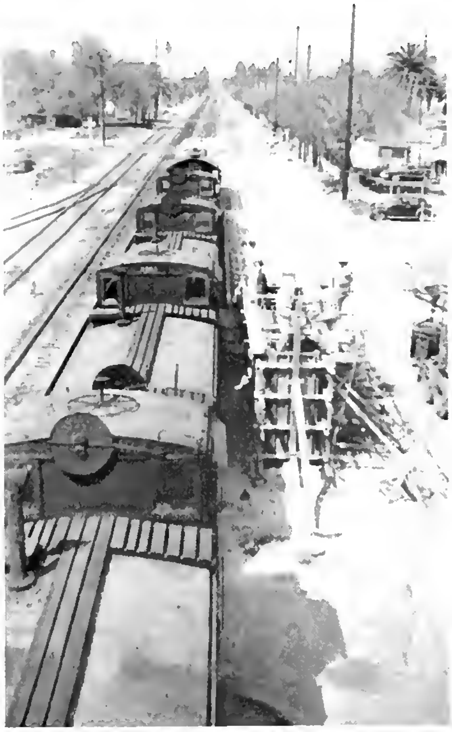
New Overhead

San Bernardino Grade Crossing Eliminated in Railroad Joint Project

By HOWARD M. EICHSTAEDT, Associate Bridge Engineer

WITH THE OPENING to traffic of the I Street Overhead on September 10, 1951, motorists and pedestrians were able to look down upon the trains and switch engines which formerly blocked Fifth Street in San Bernardino so much of the time. Although construction on the $386,000 project was started by contractor K. B. Nicholas of Ontario, last November, the project has been under consideration for the past 20 years.

The huge yards and shops and busy main line tracks of the Atchison, Topeka & Santa Fe Railway (also used by the Union Pacific Railroad) have always presented a serious traffic problem to the citizens of San Bernardino and to motorists traveling through the city. Road VIII-SBd-9, carrying U. S. 66 and State Sign Route 18, formerly crossed the Santa Fe yards on the Mt. Vernon Avenue viaduct, and increased the already heavy traffic on Third and E Streets in the heart of the downtown business section. During business hours, left turns were prohibited at Third and E, making it impossible for through motorists to follow the posted route.



Construction of Pier 4 shaft adjacent to Santa Fe main track. Piles were driven and footings poured without delay to trains.

Unusual Barrier

The Santa Fe tracks paralleling I Street provided an unusual barrier to traffic between the northwest and central portions of the city. Long, slow-moving freight trains entering the yards frequently blocked every east-west street between Third and 16th Streets, and there were innumerable switching movements across Fifth and Sixth Streets. In addition to the vexing delays to automobile traffic, conditions were a hazard to school children, interrupted bus schedules and handicapped ambulance, police and fire department services.

A survey by the City of San Bernardino in 1948 revealed that the Fifth Street Crossing was blocked an average of 4¾ hours in a 15-hour period. In some hours the gates were down for a total of 40 to 48 minutes.

City Funds Used

Meeting the problem, Mayor W. C. Seccombe of San Bernardino appeared before the California Highway Commission in April, 1948, with the city's request that Route 9 be changed from Third to Fifth Street, between the west

New I Street overhead in San Bernardino

city limits and E Street. The city agreed to use city funds to widen this portion of Fifth Street to 64 feet, and to contribute $200,000 towards the project. The commission adopted Fifth Street as Route 9 on May 19, 1948, and plans and negotiations began to take form.

In an agreement with the State, the Santa Fe Railway contributed $105,000 towards the grade crossing elimination, including its work relocating one switching track and placing telephone and telegraph lines underground to clear construction.

Overhead Structure

A steel overhead structure was selected for the separation because it could be erected with a minimum of interference with railroad traffic, and would provide maximum railroad clearance with minimum rise in grade on Fifth Street. The cost of caring for rail traffic during construction of a subway more than offset the savings in right-of-way requirements. Property fronting Fifth Street on both sides, for two blocks from H to J Street was acquired. It consisted principally of older residences.

The bridge is a symmetrical structure of three 64-foot and two 50-foot spans, providing a 52-foot roadway and two 50-foot sidewalks. A 24-foot clearance is maintained over the tracks and I Street. Abutments are founded upon steel piles driven through the fills. Raymond concrete piles were used under the pier footings. Unusual W-shaped steel bents cantilever the deck structure out from a concrete pedestal width of only 26 feet.

Box girder pier caps, 5 feet x 2 feet x 61 feet support the 36-inch WF beams carrying a concrete deck. Wrought iron blast plates were used over the two main line tracks. Erection and riveting crews moved on and off the job in 10 days, despite the difficulties, of working over the railroad. Structural steel was fabricated and erected by Consolidated Western Steel Corp. of Los Angeles, with shop inspection by H. Ross Clinton, of the Division of Highway Laboratory.

Approach Fills

Approach fills were constructed with 68,000 yards of imported borrow and paved with 3 inches of plant-mixed surfacing on 6 inches of crusher run base. Steel bridge railing is continuous on both fills from H to J Street. The terraced fills are provided with top soil and straw cover, and the entire right-of-way area is sprinklered. Delay in obtaining steel poles has postponed completion of the lighting system which covers the entire project.

Eastbound Fifth Street traffic blocked. Surveys showed these gates were down almost one-third of the time before overhead was built.

Excellent cooperation between the contractor and the railroad has produced a record of not one train delay, and an absolute minimum of delay to the contractor.

Under the terms of the City-State agreement, certain construction features preparatory to landscaping were provided in the state contract. However, all of the future development and maintenance of the landscaping is to be done by the City of San Bernardino at city expense, as a portion of the city's park system.

The graceful structure and landscaping treatment of the roadway will provide an outstanding example of the pleasing appearance it is possible to attain with an elevated roadway through a metropolitan area.

The overhead was designed by the Bridge Department under the direction of F. W. Panhorst, Assistant State Highway Engineer. District Engineers E. Q. Sullivan, retired, and S. W. Lowden of District VIII supervised design and construction of the roadway portions. H. M. Eichstaedt was Resident Engineer, and V. D. Dickinson was District Representative on construction. Mr. E. L. MacDonald, Division Engineer, represented the Santa Fe.

SIGN LEGIBILITY

UNITED STATES
DEPARTMENT OF THE INTERIOR
National Park Service
Region Two, Omaha, Nebraska

June 11, 1951

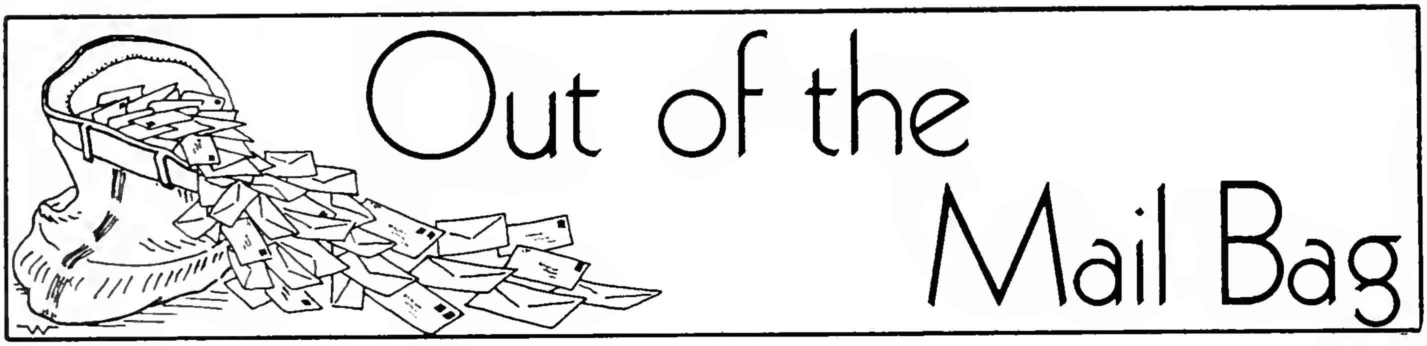
George T. McCoy, *State Highway Engineer*
California Highways and Public Works
Post Office Box 1499
Sacramento, California

Dear Mr. McCoy: Thank you very much for the courtesy shown in sending us the twelve copies of the January-February, 1951, issues of *California Highways and Public Works.*

We are presently undertaking a thorough study of the sign programs in the various national park areas administered by this office and the article, "Sign Legibility" by Karl Moskowitz, contained in the magazine will prove very helpful in developing new alphabets and sign legibility.

Sincerely yours,

Robert G. Hall
Assistant Regional Director
Chairman, Sign Committee



WE THANK YOU

MINISTRY OF TRANSPORT
Divisional Road Engineer (North Eastern)
21, Park Square South, Leeds, 1

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works

DEAR MR. ADAMS: Following my visit to California in 1949 during my highway study tour of the United States you were kind enough to place me on your mailing list for *California Highways and Public Works.*

I must congratulate you on the sustained excellence of your publication. Each issue is invariably full of interest and my colleagues and I obtain great pleasure and profit from our study of the magazine.

Thank you for the service; I look forward to receiving future copies,

Yours sincerely,

J. G. SMITH

FROM SPAIN

MANUEL MATEOS
Canteras Graniticas y Micragraniticas
(Spain) Avila

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR MR. ADAMS: I wish to express my sincere thanks for your kindness in mailing me the January-February and March-April issues of your useful magazine *California Highways and Public Works.* I have always found it extremely helpful for my interest in its questions. I know how your Country is in the vanguard about highways, and I would be pleased to continue receiving copies.

Yours truly,

MANUEL MATEOS

HIGH PRAISE

California Highways and Public Works
P. O. Box 1499
Sacramento, California

GENTLEMEN: Kindly place my name on your mailing list for *California Highways and Public Works.*

I would like to take this opportunity to commend you on your fine publication which is to me the most interesting of all highway magazines that have come to my attention. The well-written articles and the many illustrations present an excellent picture of the outstanding accomplishments of the Department of Public Works and the Division of Highways.

Yours very truly,

MELVIN CHOW
U. S. Bureau of Public Roads
Flood Building, San Francisco 2

FROM PASADENA

KENNETH C. ADAMS, *Editor*
California Highways and Public Works

DEAR SIR: I don't make enough money to pay you for the information or the enjoyment I derive from your magazine. If and when the time ever comes when you deem it essential to formalize the periodical on a subscription basis you can count on me as (I hope) one of many thousands to support you.

Thanks again and please continue the fine magazine you produce.

Yours sincerely,

NOEL MORAN,
752 Herkimer St.,
Pasadena 4

CAN EXPECT MAGAZINE

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, Calif.

DEAR SIR: As a citizen of the State of California and a motorist for 45 years I wish to express my appreciation for the privilege of receiving your interesting and informative publication on highways.

It is my opinion that the remarkable progress in quality highway construction in our State has been a large contributing factor in the development of California.

I consider it a mark of distinction for my name to appear on your mailing list and hope it will continue there for many years to come.

Very truly,

JOSEPH HARRISON BINNS
Box 500, Johnson Avenue
Los Gatos, Calif.

FROM AUSTRALIA

158 Balwyn Road, Balwyn, E 8
VICTORIA, AUSTRALIA

THE EDITOR
California Highways and Public Works
Sacramento, California, U. S. A.

DEAR SIR: I have just received my copy of your Journal Vol. 30, Nos. 1 and 2, for which please accept my thanks.

I am very grateful for your kindness in sending me this magazine which I have been receiving regularly for many years.

Yours faithfully,

J. C. BROUGH

FROM AN EDITOR

ENGINEERS' HALL NEWS

Los Angeles 46

Mr. Kenneth C. Adams, *Editor*
California Highways and Public Works
Post Office Box 1499,
Sacramento

Dear Editor Adams: I want to let you know how a citizen feels about your publication.

I think it is an outstanding public service and that other departments of our government could improve their public relations by doing likewise. That human interest item about the kid with his toy shovel at the groundbreaking for the Colorado Street Bridge in Pasadena was a honey. When a kid starts thinking at the age of four he is likely to be ahead of his grandparents.

The analyses on the effects of bypassing a town or city (in its volume of business) are very interesting as relatives of mine in eastern states write me of their woes when their state bypasses them. I mail the copies of your bulletin to them so they may see how to survive.

When I first arrived in California Hi Johnson was stumping the State for $10,000,000 in highway bonds to improve the roads. It was a Herculean task to wake the people up to the *future* needs when for years they had only been taught to think of their *present* wants. Hiram had what it takes and he could make his enemies scuttle for cover like scared rabbits. From that time on it was easier to get money for roads.

Safety must be stressed more and more and I believe that the weeding out of unfit drivers should be carried on more vigilantly. The tests for drivers licenses should include a co-ordination test same as the major trucking companies and cities and counties put their drivers through. This could be softened by limiting the slow ones with a license that would be revoked if they drove above a speed that the test showed safe.

Many thanks and keep up the good work.

Sincerely,

E. F. Jackson.

GOOD INVESTMENT

FORD MOTOR COMPANY

Long Beach 1

Mr. R. M. Shillito
Special Assistant to Director
Department of Public Works
Sacramento, California

Dear Bob: I want to thank you for the Centennial Edition of *California Highways and Public Works*. I look forward to each succeeding issue and never fail to find them interesting. Since I use up so much of the highway system, I really appreciate the effort and planning that goes into making the California highways so pleasant for driving. The $150 a year I spend on gasoline taxes probably brings me more value per dollar than any other similar expenditure I can think of.

Sincerely,

Lowell L. Lewis
Service Representative
Ford Division
Ford Motor Company

PRAISE FROM TEXAS

State Highway Department
Sacramento, California

Gentlemen: Today I am fulfilling a promise to myself which was made during my trip across your State recently. Every time I go away from home I make the same promise that when I return, I will write the Highway Department to thank you for the wonderful roads that you have provided for us.

Since the coming of the automobile, approximately three decades ago, you have apparently met a great challenge which this industry has placed upon you. Wherever we went in California, it was smooth riding and your officers were most courteous to us.

We want to thank you for making our trip a pleasant one.

Sincerely yours,

Mrs. Carl L. Boyles
4021 Gulf Street
Houston 17, Texas

FROM A BANKER

BANK OF AMERICA
San Diego Main Office

Mr. Kenneth C. Adams, *Editor*
California Highways and Public Works
Post Office Box 1499
Sacramento, California

Dear Mr. Adams: I should like to go a little bit further than simply returning the postal card in indicating my interest in receiving *California Highways and Public Works*. Many years ago I read the magazine regularly. Upon moving to San Diego in 1946, I somehow failed to receive it, but Ed Wallace kindly put my name back on the list last year. I always found the magazine interesting and instructive, but there has been a very outstanding improvement in the publication as compared with some years past.

I know that it is an expensive magazine to produce, but I feel the State Highway Department has a job that is more far reaching than simply laying out and building highways. Some of us have been in the midst of controversy over highway locations, and I believe we have become impressed with the fact that the department has a public relations and selling job to do. Through the magazine, especially in articles such as the ones relating to Temecula and Escondido in the current issue, a lot is being done and this material in the hands of some of us does provide good background material for public talks and discussions. If some way could be devised where this information could reach an even larger number of people, it might minimize the problems we all have in attempting to work out highway locations.

About a year ago when the new section of Highway 395 was opened, Mr. Purcell, Mr. Baker, Mr. Leigh and myself discussed this subject at some length, and I know of the public relations job which the department is doing.

I appreciate very much the opportunity to continue seeing the publication.

Very truly yours,

Graydon Hoffman
Vice President and
Manager

Unusual Fill

Stabilizing a Highway Over an 80-Foot Depth of Mud

By PERCY A. MAIN, Assistant Highway Engineer

During the past two construction seasons, the California Division of Highways has reconstructed a section of State Highway Route 15 (State Sign Route 20) across Tule Lake, about three miles west of Upper Lake, Lake County, where the road grade located below normal high water was often flooded.

History

The existing road crossed low-lying terrain drained by Bachelor Creek. During periods of high runoff, however, water backs up in nearby Scotts Creek, into which Bachelor Creek empties, resulting in flooding the terrain during maximum floods to a depth of 14 to 15 feet or to an elevation 1,339.0 at the highway crossing, thereby forming Tule Lake.

After the water in Tule Lake recedes to its normal level in the late spring, the local reclamation district pumps the balance of the water into Clear Lake so that the lake bottom can be farmed.

The original highway was contructed across Bachelor Creek Valley in 1922 to approximate elevation 1,335, which was approximately 10 feet above the ground surface. Between 1922 and 1950 the fill subsided continuously, approximately five feet in that time. This vertical settlement was accompanied by considerable lateral displacement in the surrounding mud.

Road Raised Above High Water

In order to eliminate this flooding of the road and its resultant closure to traffic during winter storms, requiring the detour of traffic over a county road, which added 1.6 miles to the route, a decision was made to remedy the situation by raising the grade to an elevation above high water. To accomplish this would require raising the old fill approximately 12 feet. Construction to this grade would require an increased fill of approximately 17 feet total height above the adjacent ground surface.

The unstable character of the foundation soil was evidenced by the continuous settlement of the relatively low existing embankment. An investigation was made to determine the feasibility of the proposed fill and the stabilization treatment necessary to obtain a stable roadbed.

Deep Borings Made

Four power borings were made; the depths varying from 67 feet to 100 feet. Moisture and density determinations were made on all retained cores, and numerous grain size analyses were made. Consolidation and shear tests were made on undisturbed samples taken at various depths.

These test data were used in analyzing the stability of the foundation soil, computing settlement, and comparing various methods of fill treatments.

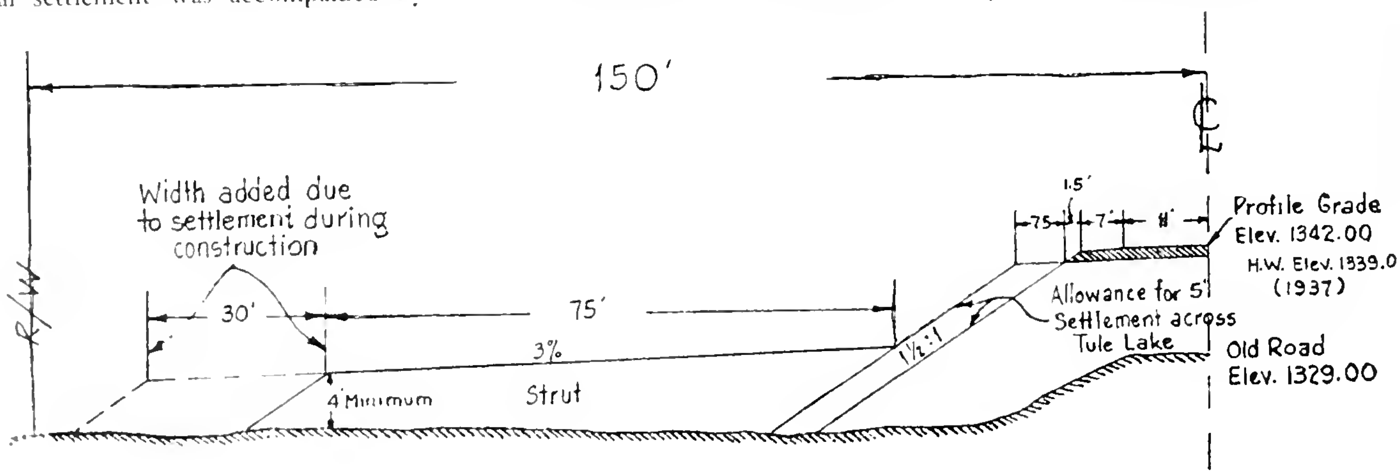
Borings indicated that Tule Lake is a filled bay of Clear Lake with soft, gray, silty clay extending to a depth of approximately 85 feet. This soft mud is underlain by relatively firm material, ranging from clayey sand to gravel.

The moisture content of the silty clay varied from 63 percent to 86 percent in the cores tested, with unit wet weights of from 88 to 112 pounds per cubic foot. (*See summary Chart 1.*)

Alternate Methods

Following is a description and comparison of the several alternate methods of embankment construction with special consideration of the probable subsequent stability and subsidence of the fill.

(a) Construction of embankment without any treatment and with no counterweight struts was considered to be unsafe. The computed factor of safety would be less than unity, and fill failure during construction could be expected. Such a design was not considered feasible.



½ Typical Section Across Tule Lake Bottom

Two views of Tule Lake fill, looking west

Toe Support Fills

(b) The analyses indicated that, by carefully controlling the rate of embankment placement and by constructing counterweight or "toe support" fills, it might be possible to construct the fill without excessive lateral displacement of the underlying mud. However, the computed factor of safety was approximately unity so that the fill would have to be brought up slowly. The subsequent settlement would continue for many years, and after about five years would be sufficient to necessitate additional fill if the grade line were to be kept above high water.

(c, d) Construction of a fill with sand drains to a depth of 50 feet, without or with counterweight strut fills, would entail costs which would be prohibitive. The subsequent settlement would be much less than for the embankment without sand drains; the subsidence due to consolidation of the foundation soil after construction would probably be less than two feet in 10 years, so that no major reconstruction would be required to maintain the grade above high water for 10 years or so.

Sand Drain Treatment

(e) The other alternative studied was sand drain treatment for the full depth of mud. To minimize the danger of fill failure during construction by lateral displacement of the mud and to permit more rapid placement of the fill, a counterweight fill was included in this design. The subsidence due to consolidation after construction would be relatively slight, probably less than a foot in the first 10 years and almost negligible thereafter.

Considering all the factors, it was concluded that the design for minimum ultimate cost of construction and maintenance would be the construction of the embankment to a nominal height above high water with no special treat-

This is another photograph of Tule Lake fill, looking east

ment except the counterweight fills and controlled rate of placement. Additional increments of embankment and surfacing would be necessary at intervals of perhaps five years in order to maintain a grade above high water, but would eventually reach stability.

After these studies of foundation stability, fill settlement and economic comparisons, a decision was made to construct an embankment and toe support fill without foundation treatment, with careful control of rate of fill placement. The drainage structures were to be placed on a blanket of gravel. Although this method would require periodic additions to the fill as settlement occurred, economic comparisons indicated it would be cheapest in over-all ultimate cost.

Stability Safeguards

Before the fill was started, 4 foot x 4 foot timber settling platforms with 3/4-inch vertical pipe indicators were placed at three locations on the centerline of the old fill and on the original ground 105 feet right and left of centerline. Iron pins were driven in the ground at 50-foot intervals out to 250 feet from centerline. Elevations were taken of these points daily, and settling or heaving was noted.

In order to guard against a too rapid placing of the fill that would result in an accumulation of pore pressure in the underlying soil, well points were installed at depths of 14, 30, and 45 feet below original ground line. These well points were placed at the right toe of the old fill and connected by copper tubing to pressure gauges placed outside the limits of the road fill.

The pressure registered on these gauges was recorded daily and plotted on a chart. The chart was important, as the rate of change was probably more significant than the actual value.

The rate of fill placement was further controlled by a clause in the specifications specifying that not more than 1/8-inch lift be placed in any 24-hour period.

Construction

The contractor started placing the embankment on June 15, 1950, and the rough grading was completed on October 3, 1950, with 120,000 cubic yards of embankment used in the fill.

The counterweight or strut fills were constructed first, leaving the old roadway for the use of traffic. After the strut fills were completed, traffic was routed over the left strut, and the main roadway prism was constructed as specified. 0.75 feet of imported base was placed between October 4 and 13, 1950. Then 0.50 feet of road-mixed imported base cement (2 percent) treated was placed between October 16 and November 4, 1950. One-half inch of road-mixed surfacing was placed November 24 and 27, 1950, as a maintenance course for the wet winter suspension period.

The balance (2½ inches) of road-mixed surfacing was placed June 11, 1951.

Behavior of Fill

The behavior of the pressure gauges was in some respects disappointing or at least difficult to interpret.

The well points as stated above were placed at depths of 15, 30, and 45 feet. The 30- and 45-foot depths were selected because of the width of the fill which, including the struts, was 250 feet wide. It was assumed that the bulb of pressure caused by the weight of fill would extend to approximately 50 feet during the construction of the

struts and to a considerably lesser depth for the balance of the fill.

The pressures measured for the 30- and 45-foot depth confirmed the original assumption; however, significant pressures were never obtained on the 15-foot depth.

Plastic Flow

The failure to record any pressure at the 15-foot depth is hard to explain in view of the plastic flow which occurred, particularly at Station 316+50. The increased rate of settlement at this location was accompanied by heaving at 150 feet from centerline. Further evidence of plastic flow was lateral movement of the newly constructed property fence and cracks which appeared in the strut fill.

Additional well points which were installed as a check on the original installation indicated no pore pressure.

The settling platforms indicated that the mud subsided at a uniform rate as was originally estimated with the exception at centerline Station 316+50 between August 29 and 31, 1950, 1.3 feet subsidence was recorded. This sudden subsidence at this one station has gone unanswered, as it cannot be correlated with any sudden change in pressure gauge readings or in heave point readings.

Strut Fills Widened

When this sudden subsidence occured, a decision was made not to place any more embankment across the unstable area until September 18, 1950, and then to widen the strut fills to the right of way lines before the roadway prism embankment was completed. The strut fill embankments were completed on September 26, 1950, and the roadway embankment on September 30, 1950.

Between June 6, 1950, and October 14, 1950, while embankment was being placed, a maximum subsidence of 4.3 feet was recorded at centerline Station 316+50.

Between October 14, 1950, and May 29, 1951 (date of last elevation taken), the embankment has subsided a maximum of 2.3 feet or a total of 6.6 feet.

Personnel

The project was carried out in District I, California Division of Highways; A. M. Nash, District Engineer; C. P. Sweet, District Construction Engineer; W. R. Lovering, District Materials and Testing Engineer. Field operations were under the immediate direction of the author, who was Resident Engineer.

The contract was carried out by Contractor M. W. Brown, Redding, California, on a bid of $191,432.60. V. M. Dwyer was the contractor's superintendent on the job.

SETTLEMENT DUE TO CONSOLIDATION

Ultimate far 80-Foot Depth Mud

Type of fill construction	Profile grade of const.	d= 60′	d= 80′	One yr.	Five yrs.	Ten yrs.	Factor of safety
(A) No treatment	1,344	8	10	2	3.5	4.3	0.7
(B) No drains, 5′ x 75′ counterweights	1,344	8	10	2	3.5	4.3	1.1+
(C) Sand drains 50′ deep, no counterweight	1,341	8	10	7.6	8.4	9.0	Over 1
(D) Sand drains to solid, no counterweights	1,341	8	10	8.5	9.0	9.3	1±
(E) Sand drains to solid counterweights 5′ x 35′	1,341	8	10	8.5	9.0	9.3	Less than 1

Land Economics

Continued from page 37 . . .

tions. An analysis of all the pertinent facts concerning six by-passed cities, ranging in population from 1,700 to 6,500, has developed the conclusion that the diversion of through traffic by such highway construction is not detrimental, but is beneficial to real estate values and stimulates retail business activity.

The magnitude of the benefits to be derived from a freeway by-pass is directly proportional to the degree of traffic congestion created by the merging of excessive through traffic with local traffic.

Summary

A summary of the net effect of freeway by-passes on retail business volume in the six cities studied, computed by comparing the average volume change of the retail business establishments located along the by-passed streets with the average change in volume of similar business establishments generally in the vicinity during the same time period before and after the highway improvement, is as follows:

	Population	No. of businesses by-passed	Net effects on business by type: Cafes—Bars	Service stations	All others
North Sacramento	6,016	224	+11.5%	+25.5%	+21.5%
Auburn	4,577	74	+ 5.0%	+21.0%	0.0%
Fairfield	3,607	70	−24.4%	−23.0%	+14.1%
Folsom	1,706	36	+ 7.4%	+ 5.0%	— 1.0%
Imperial	1,736	21	+ 1.5%	+ 2.72%	+ 0.5%
Escondido	6,608	67	+11.95%	+25.6%	+12.7%

In addition to the development of conclusive proof of the beneficial effects of freeway by-passes, studies of the effects of frontage road installations have been completed up to the present time in four locations involving 61 businesses. These studies have indicated that the advantages of a local or frontage road for business purposes ordinarily exceed the detriments of some circuity of travel imposed by the separation of the through traffic lanes from direct access to abutting properties.

THAT'S THEIR JOB

BIG BEAR LAKE VALLEY CHAMBER OF COMMERCE

BIG BEAR LAKE

MR. S. W. LOWDEN
District Engineer, Division of Highways, District VIII, P. O. Box 231, San Bernardino

DEAR MR. LOWDEN: On behalf of the community the Big Bear Lake Valley Chamber of Commerce wishes to express its appreciation for the cooperation of the State Division of Highways in repairing the damages to the streets of the village and the highways in this area,

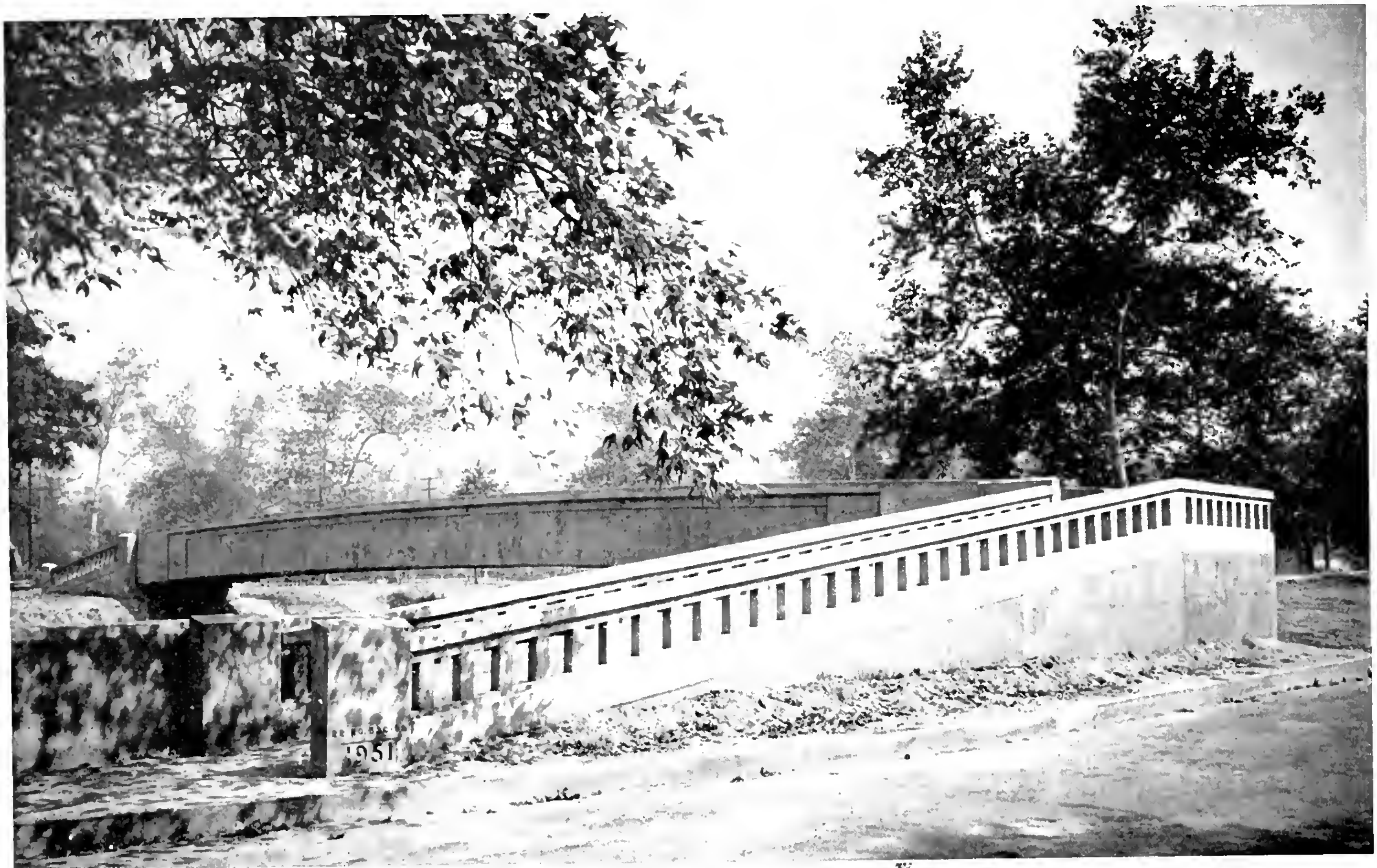
We fully appreciate the alertness of your division foreman and his crew and their readiness to meet an emergency. They were out with equipment to clear the highways of rocks and debris and to start the repair work as soon as the storms abated.

Our sincere thanks.

Very truly yours,

BIG BEAR LAKE VALLEY CHAMBER OF COMMERCE
WILLIAM KLEINMAN, *President*

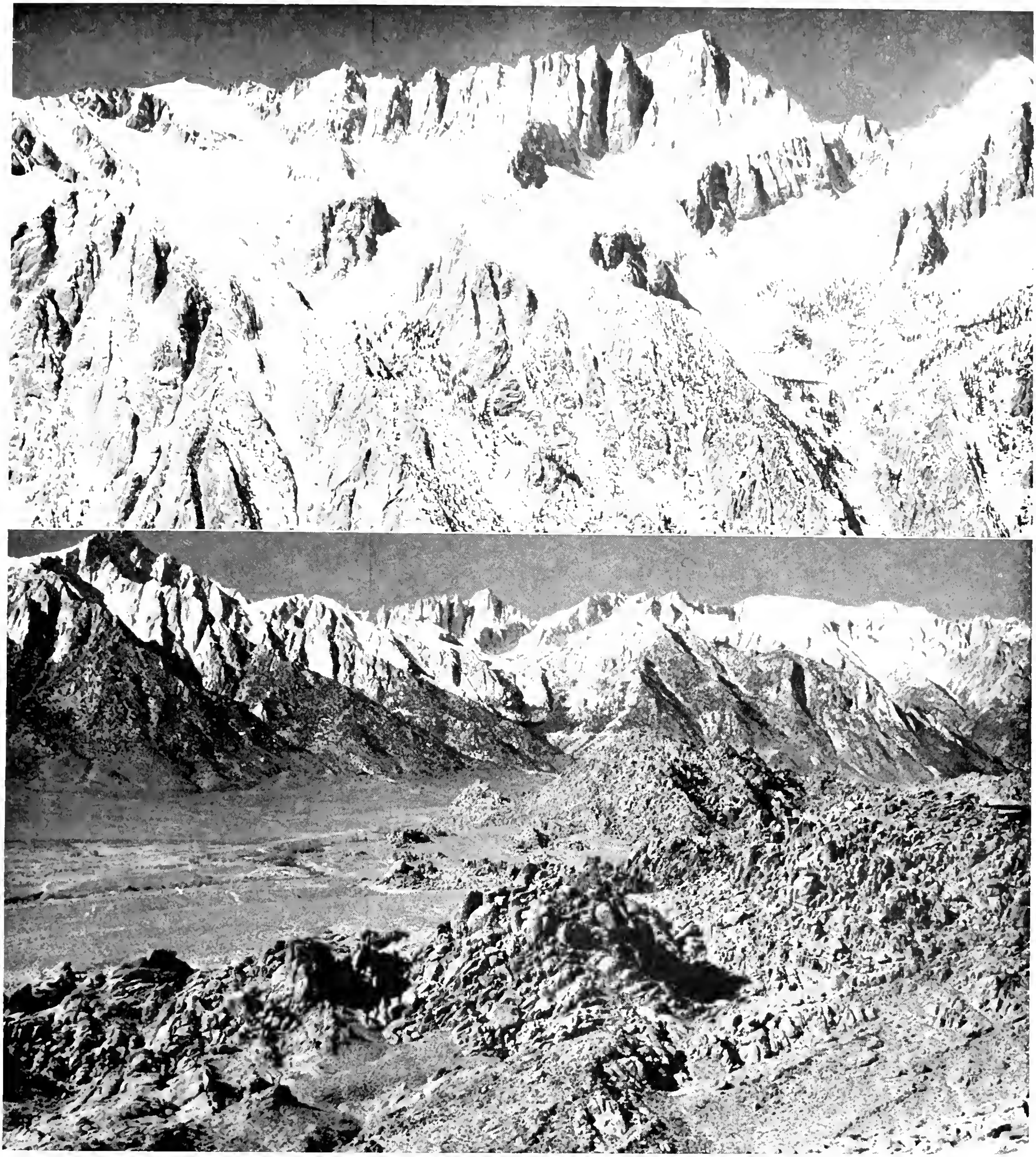
HERE IS HOW FIRST PRESTRESSED BRIDGE LOOKS COMPLETED



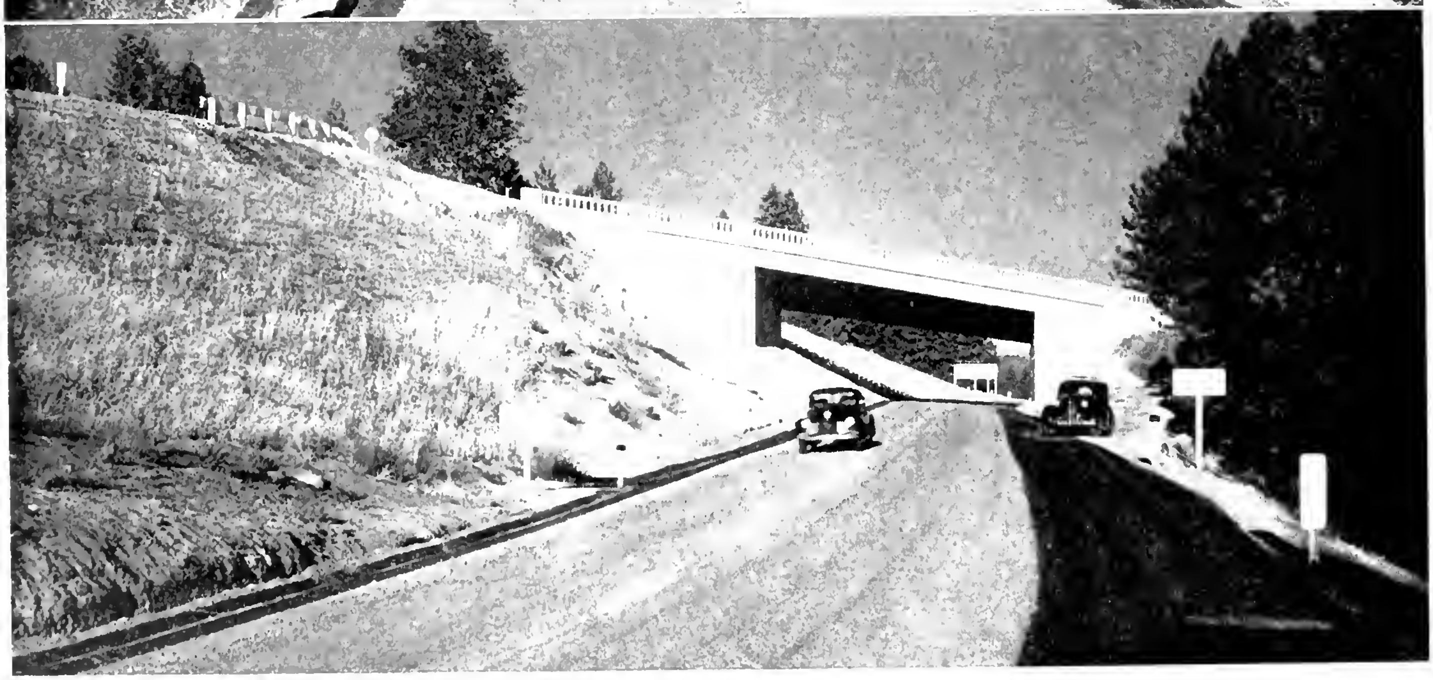
California Highways and Public Works has had many requests for photographs of the completed prestressed pedestrian bridge across the Arroyo Seco flood channel in Los Angeles. This is how the finished project looks.

The bridge, first of its type in the West, makes use of the new engineering principle called "prestressing," said to be one of the most noteworthy advances in concrete construction since the invention of Portland cement. Nation-wide attention was attracted because the prestressed design is a radical departure from previous types of conventional concrete bridges.

Prestressed concrete, a development of European scientists, is still in its infancy in this Country. A complete description of the structure appeared in the issue of this magazine for March-April, 1951.



This is the time of year when world-famous Mt. Whitney in Inyo County, California, begins to mantle itself in snow. Each summer thousands of tourists visit this shrine of lovers of Nature's magnificent and inspiring handiwork. The aerial view (top) was taken by Bob Symons of the Symons Flying Service, Bishop, at an elevation of 15,000 feet from the east side of Owens Valley. The lower photograph was taken by Harry Lee of Lone Pine and shows the Whitney Portals Road leading to the basin below the mountain and was shot from the Alabama Hills.



New City Creek highway. UPPER This view is looking towards San Bernardino. LOWER City Creek bridge at intersection of City Creek highway and State Route 43.

Mountain Road

Continued from page 35 . . .

Arrowhead Our Lady of the Lake Catholic Church, asked God to bless those who traveled the new highway, which, he said, 'is symbolic of that greater highway which all mankind is traveling on their way back to God.'

High Gear Road

"Mayor George C. Blair paid respects to the Highway Commission members who so patiently hear the complaints of those who would object to the progress of highways. Lt. Col. Earl R. Knauer, who represented Brig. Gen. F. C. Langmead, commanding officer of Norton Air Force base, referred to the City Creek Freeway as

Spectators crowd near the ribbon on the strip of the highway which goes through Running Springs as the parade approaches. In the lead car is Lieut. Governor Knight; behind him is State Senator Cunningham's car.

'another refund on the gas tax paid by those who use the highways.'

"The winding ribbon of pavement and bridges, laid through man-made cuts into the mountains, is strictly a high gear road even for older model cars. It was given a thorough test on its official opening day by thousands of automobiles, many drivers of which stopped off to admire the view back into San Bernardino Valley from the many observation points.

"Running Springs businessmen, led by Lloyd Soutar, welcomed Lieutenant Governor Knight and other guests. Serving on his committee were James Soutar and Don Henderson.

"The kiddie carnival opened activities Saturday. Prior to the first night show staged by Miss Hutton and her orchestra, the Arrowbear Music Camp, conducted by Fred Oldendorf, presented a concert."

CONTRACTS ON CITY CREEK HIGHWAY

Limits	Length, miles	Construction cost	Completion date	Contractor
1. Highland Avenue to City Creek Bridge	3.2	$783,000	4-12-48	Denni Investment Corp.
2. City Creek Bridge to Plunge Creek	4.3	892,700	10-27-48	Westbrook & Pope
3. Plunge Creek to Long Point	1.8	843,800	8-12-49	Claude Fisher Co. Ltd. and L. R. and R. S. Crow
4. Long Point to 1.3 miles west of Running Springs	4.0	934,900	11-15-50	Frederickson & Kassler
5. 1.3 miles west of Running Springs to Running Springs	1.7	446,000	9-14-51	Hess Const. Co., Inc.
Totals	15.0	$3,900,400		

CONCENTRATION

Put all other thoughts aside when you drive except those concerned with driving well. The motorist who thinks about business or domestic problems when driving can be a highway hazard.

SAFE WALKING HABITS

When you're walking where there's traffic, observe the signs and watch the lights. Help prevent pedestrian accidents by doing your part.

PROFESSOR WRITES

UNIVERSITY OF FLORIDA
College of Engineering

California Highways and Public Works
Sacramento, California

DEAR SIRS: This is to express my appreciation for your magazine *California Highways* which you have so kindly sent me while here at the University of Florida.

Your coverage of the work in the highway field is of vital interest to us in this field. The illustrations contained in all of your issues have been wonderful examples for presentation for class work. Our text "Highway Engineering" which has just been published by the Ronald Press Company of New York has a few examples from your state highway department and if we were not limited we would have liked to have more of them. In other words, we like your magazine very much and it finds a place in our work.

Yours very truly,

RADNOR J. PAQUETTE
Assistant Professor of
Civil Engineering

HE KNOWS HIGHWAYS

WOODROW MILLER HONEY COMPANY

MR. BALFOUR, *Chief Right of Way Agent,*
California State Highway Commisison

DEAR MR. BALFOUR: I want you to know that I appreciate the fine job the California State Highway Department is doing in providing roads in our State to meet the demands of the increased traffic. As you know, I have branches of my business scattered through other western states and in Nebraska. I do considerable driving over roads of other states that do not even approach the caliber of those of California and I constantly think of the good job our California State Highway Department is doing. Any little contribution that I can make to your efforts, it is a privilege for me to be called on to do so.

Only the best,

WOODROW MILLER

Cow Palace

New State Highways Make Travel To National Livestock Show Easy

More than $3,300,000 of improved thoroughfares in the immediate vicinity opened this year will make it possible to get to the Grand National Livestock Exposition at Cow Palace in San Francisco more easily than ever before.

The first improvement opened to the traveling public was the one-mile freeway between Army Street and Alemany Boulevard, an integral link of the Bayshore Highway. With its overpasses and expansive lanes for fast travel, this link was completed after nearly a year of work and the expenditure of more than $3,000,000.

More of the same is in the blueprint stage and eventually will be made a reality in an effort to handle the continually increasing travel safely and swiftly.

Another improvement that will be of particular advantage to those coming from the south and valley points is the added lane on each side of the Bayshore between the southern city limits of San Francisco and the northern limits of South San Francisco.

Now a six-lane highway for that distance, the work was done under Division of Highway supervision at an estimated cost of $300,000.

Opens October 26

Travel to the Cow Palace over these two new units will get under way long before the Grand National opens its 10-day run, October 26th. Livestock exhibitors by the hundreds, rodeo performers, horse owners and other participants in the impressive livestock and arena spectacle will van many of their entries to the Cow Palace several days in advance.

With an all-time high in premiums to be paid in the livestock division, this feature of the Exposition will be highlighted by Golden Gate National Hereford Show, an integral part of the Grand National this year.

This is the first time since 1939 that the American Hereford Association has held an officially approved show on the Pacific Coast.

UPPER—Famous Cow Palace in San Francisco. LOWER—Section of Bayshore Freeway which makes travel to the Cow Palace easy.

In 1939 the show was staged in connection with the Golden Gate International Exposition on Treasure Island.

A total of $20,000 in premiums will be offered in this one division alone. An additional $72,924 will be offered in premiums to owners of other beef cattle, dairy, dual purpose cattle, swine and sheep.

Big Arena Shows

Further highlights will be the arena shows to be presented 14 different times during the period, October 26th to November 4th, inclusive. Matinees will be staged on Saturday and Sunday, October 27th and 28th and on the following Saturday and Sunday, November 3d and 4th.

Dude Martin and His Roundup Gang will lend an air of color and song to the show never heretofore offered the public. He will offer "Roundup on the Range," a real life story as it was

. . . Continued on page 58

Equipment Operator Gets Merit Award Check

Another idea which will save money! Highway Maintenance Equipment Operator H. M. McAllister of Sacramento suggested that if mowers were equipped with tire repair kits delays by punctures would be shortened. Less idle time will mean a considerable saving to the State. The Merit Award Board thought well of the idea. District Maintenance Engineer R. I. Nicholson is shown above presenting a certificate of award to Mr. McAllister, together with a check for $25. Maintenance Superintendent Clyde W. Rust beams his approval.

Headquarters Shop

Continued from page 28 . . .

Cleaning operations of Headquarters Shop, with the exception of administrative and accounting offices, is a function of the Parts Department. This cleaning is done by a crew of five employees who also act as watchmen over the entire Headquarters area of the Equipment Department.

In order to accomplish its assigned tasks the Parts Department must use a number of automotive units in its pick-up and delivery service.

Automotive Equipment

Automotive equipment assigned to the Parts Department is composed of two pick-up trucks, one flatrack truck, one five-ton truck-tractor, and one 15-ton semitrailer. The pick-up trucks are assigned for use of Parts Department employees for emergency purchases, delivery and return of work to be performed on service orders and other transportation needs as required. The flatrack truck is used for general utility purposes. The large truck-tractor and semitrailer is used for "over-the-road" hauling of equipment, material, and supplies between Headquarters Shop, district shops, and other state agencies. One equipment operator-laborer, assigned to the Parts Department personnel, is regularly assigned to operate the large transport unit.

Parts Department functions have been broken down into four general classifications. Certain employees have been assigned to each classification on a rotation basis. The rotation of personnel and duties will preclude any possibility of a breakdown in operations due to any authorized absences or turnover of personnel.

District Shops

In addition to the Parts Department activity at Headquarters Shop, there are parts and stores carried in nine of the eleven district shops. The acquisition of repair parts for district shops 3 and 10 is handled through Headquarters Equipment Department. The District Shops Parts Department activities are staffed with a total of 26 employees composed on nine machine parts storekeepers I, and 17 assistant machine parts storekeepers. Twelve rotary card files have been purchased for use of district shops parts departments and will be installed with the various new types of records. All procedures and records are being standardized in all shop parts departments so that this phase of activity will be coordinated.

The following schedule lists parts department locations, number of employees, rotary files used, and stock cards maintained:

Shop	Location	Employees	Rotary files	Stock cards
HQ	Sacramento	22	2	7,000
1	Eureka	3	1	3,500
2	Redding	5	2	6,000
3	Marysville			*1,500
4	Fruitvale	2	1	3,500
5	San Luis Obispo	2	1	3,000
6	Fresno	4	2	5,000
7	North Hollywood	4	2	6,000
8	San Bernardino	2	1	3,500
9	Bishop	2	1	3,000
10	Stockton			*
11	San Diego	2	1	3,000
		48	14	45,000

* General shops are not maintained at Marysville or Stockton. Other than field repairs and maintenance, all overhauling of equipment is performed by Headquarters Shop. The stock cards listed for Marysville cover repair parts carried at Donner Summit Maintenance Station for emergency repairs made mostly to snow removal equipment.

The Parts Department is an important activity and its task of procuring needed parts and supplies for the repair and maintenance of equipment of prime importance. Its growth and expansion reflects the policy of the department to increase the number of services rendered and more efficiently perform the work of repairing equipment.

HEADLIGHT TIP

When starting on a trip that may require night driving, have the headlights checked and adjusted with the car fully loaded. The extra weight may direct the light beams too high for safe driving.

R. M. Shillito Resigns From Department

Appointed in May, 1950, by the late Director of Public Works C. H. Purcell to be his special assistant, Robert M. Shillito handed to Director of Public Works Frank B. Durkee his resignation to become effective October 1st.

Shillito gave up his post as director of the highway and transportation department of the California State Chamber of Commerce to accept Mr. Purcell's appointment. Shillito has accepted a position as assistant general manager of the San Francisco Chamber of Commerce. He will be missed in the Department of Public Works.

ROBERT M. SHILLITO

Shillito is a graduate of the University of California at Los Angeles. During the war served in the South Pacific and the Pacific theaters as aircraft maintenance engineering officer with the 403d Troop Carrier Group of the 13th Air Force. In 1946, he was employed as Director of Public Relations for the Southern California Council of the California State Chamber of Commerce, with headquarters in Los Angeles. Subsequently he was assistant manager of the Southern California Council until 1948 when he became director of the State Chamber's Transportation and Highway Department in San Francisco.

Redding-Red Bluff

Continued from page 10 . . .

will be required as traffic warrants, particularly adjacent to cities. Outside of cities it will be an expressway with controlled access openings.

All this work was performed under supervision of District II at Redding. F. W. Haselwood was District Engineer until his retirement in June, 1950. Since that time, J. W. Trask has been District Engineer. The writer was Construction Engineer on all the work.

Views of the old and new sections of highway south of Redding

State Buys Spans

Continued from page 11 . . .

in 14 years, after which the two bridges would become toll-free.

Following receipt of word that all the financial details had been completed, many of the old employees of the San Mateo-Hayward Bridge, who became state employees under the transfer, gathered around the flag staff near the toll bridge office as the Stars and Stripes and California Bear Flag were hoisted. Toll Sergeant Charles E. Smith, Vice President of the California State Employees' Association, pinned the official state badge on Toll Collector Wilbur Brown, one of the oldest employees of the former privately owned span.

A similar flag raising ceremony was staged at the Dumbarton Bridge, both events being supervised by Bridge Engineer Edwin Levy, who will have charge of the two spans for the Division of Highways.

A San Mateo man, R. A. Osten of 511 North El Camino Real, San Mateo, was the first to benefit by the toll reduction on the San Mateo-Hayward Bridge.

This machine enabled Frank B. Durkee, Director of the State Department of Public Works, to sign 20 bonds at once for the $8,350,000 issue to purchase the San Mateo and Dumbarton bridges across San Francisco Bay. There were 8,350 bonds to sign and the machine cut the time for signing from a week to two hours.

New Link

Continued from page 18 . . .

Referring to the growth in traffic, Baker stated that the section that was opened on December 27, 1950, from Grand Avenue to Silver Lake carried an average of 32,000 cars per day the first week after it was opened, and three months after it was opened it was carrying an average of 38,000. The last traffic count on the first section of the Hollywood Freeway taken in July, 1951, showed that an average of 44,000 cars per day were using the freeway.

STATISTICS

Here are statistics regarding the section of Hollywood Freeway between Virgil Avenue and Western Avenue in Los Angeles:

Length—1.7 miles

Total cost of right of way—$4,935,-400

401 houses within right of way

392 houses moved

9 houses razed

9 commercial buildings within right of way

4 commercial buildings moved

5 commercial buildings razed

Total estimated construction cost—$4,893,300

Immediately following Baker's remarks, the ribbon across the freeway was officially cut by J. Kingsley and Baker with the help of Lt. Governor Knight and James A. Guthrie, Highway Commissioner from San Bernardino. A caravan of cars was immediately started and traveled the length of the new section to Silver Lake, returning to Western Avenue.

The entire dedicatory ceremonies were run off in rapid-fire order by Kingsley and took about 40 minutes from the beginning to the cutting of the ribbon.

PUBLIC PARKING AREA IN ROSEVILLE

By GILBERT MULCAHY
District Right of Way Agent, District III

In a cooperative venture between the State of California and the City of Roseville, the parking situation in Roseville has been greatly improved by the utilization of some right of way not presently required, for an off-street public parking area under the management and control of the city.

Looking westerly across Roseville's free parking lot in the foreground one block from the center of the business district. The street bisecting the picture is the new section of U. S. 99E near the south ramp of the underpass across the railroad yards.

Construction of the Washington Street Underpass across the yards of the Southern Pacific Company in Roseville, completed May 10, 1951, created an additional parking problem in the business center of town by eliminating all the former parking available on both sides of Washington Street for two blocks.

Near the end of construction of the highway project through Roseville, disposal of surplus excavated material became a problem. The State had acquired an entire ownership of land westerly of Lincoln Street because of excessive damages to the remainder. The portion outside of the normal right of way, between Dry Creek and the Lincoln Street connection, was approximately 10 to 15 feet lower than Lincoln Street and the adjoining state highway. Some of the excess material was used to fill this area up to approximately the grade of Lincoln Street and the adjoining state highway.

Naturally concerned about the aggravated parking situation, Roseville officials, under the leadership of Mayor Harold T. Johnson, now State Senator, investigated the possibilities of using this level area only one block from the center of the city for public off-street parking. Since it was recognized that highway traffic and parking problems go hand in hand, an agreement was reached with the City of Roseville whereby the surplus land, comprising 1.62 acres was leased to the city for a free public parking area and public park at the nominal rate of $1 per year. Not all of the 1.62 acres had been filled in, and the city wished to use the portion adjoining Dry Creek to extend the deer runs of the adjoining Royer Park.

The public parking area was surfaced, signed, and put in operation by the City of Roseville about March of 1950. Lights have since been installed by the city and landscaping of the entire highway project through Roseville, now underway, is adding to the attractiveness of the site. With a capacity of 80 cars, this parking area absorbs the overflow from Vernon and Lincoln Streets, the two main business thoroughfares.

Roseville is justifiably proud of this public service which costs it a rental of only $1 per year and relieves the State Highway Department of maintenance costs until the property is used for the future highway which is planned.

Freeway Values

Continued from page 5 . . .

may be found in the comparison of the $7,000 to $10,000 per acre values just discussed to the highest price and most recent sale of industrial property in this immediate vicinity—served by the freeway, but not visible therefrom. This price was $5,000 per acre, in itself a considerable jump from the values existing prior to freeway construction.

Near the north end of the four-mile long North Sacramento freeway on the portion of U. S. Highway 99E still conventional highway, top land values indicated by various listings are $5,000 per acre, the best use being commercial.

All this brings us to the conclusion that the many advantages of a fast, safe uncongested highway facility, which are to be found only in freeways, have a pronounced beneficial effect on values of the abutting lands which they serve.

Cow Palace

Continued from page 54 . . .

lived by early day cowboys. The story will be emphasized in music and song to add further to the colorful life of the pioneer cowmen.

Two other new features that help to bear out the theme of newness throughout will be the Boom Town Quadrille, a cast of 18 horses and riders doing square dance numbers to the tunes reminiscent of early America, and the Wild Horse Stampede.

Horses that are just as wild as their names imply will be turned loose in the arena and 50 cowboys will have the task of riding them. They will have no rope, bridle or saddle to aid in this maneuver. Only the horses' mane will be available for their use in riding these mustangs.

The rodeo will culminate the 1951 season for the International Rodeo Association with points won at this meet determining the championship for the year.

HIGHWAY BIDS AND AWARDS

August, 1951

ALPINE COUNTY—Between 1.5 and 2.5 miles northeasterly of Woodfords, between Markleeville and two miles southeasterly thereof and across Silver Creek about 10 miles southerly of Markleeville, a total net distance of about 1.1 miles, roadbeds to be graded, I. B. M. to be placed, B. S. T. to be applied, the existing bridge over the East Carson River about 1.5 miles southeasterly of Markleeville to be repaired and a new reinforced concrete bridge to be constructed across Silver Creek. District X, Routes 23, 24, Sections C, C&D. R. P. Shea Co., Indio, $324,968.75. Contract awarded to Eaton & Smith, San Francisco, $255,113.

ALPINE COUNTY—Between 1.3 miles and 2.6 miles east of Picketts, about 1.3 miles to be graded, surfaced with roadmixed surfacing on imported base material and a reinforced concrete girder bridge across West Fork of Carson River to be constructed. District X, Route 23, Section E. Eaton & Smith, San Francisco, $281,760; R. P. Shea Co., Indio, $337,-514. Contract awarded to Harms Bros., Sacramento, $257,203.

CONTRA COSTA COUNTY—Over Refugio Creek and Hercules Powder Co. roads at Hercules, the existing timber trestle bridge to be repaired. District IV, Route 106, Section Her. B. S. McElderry, Berkeley, $21,964.50; Barton Construction Co., Oakland, $18,212.57; James H. McFarland, San Francisco, $15,707. Contract awarded to Bos Construction Co., Oakland, $14,854.

DEL NORTE COUNTY—Portions along the Smith River between 27.1 miles and 30.8 miles northeast of Crescent City, about 0.4 mile in net length, storm damage to be repaired at two locations. District I, Route 1, Section E. Mercer, Fraser Co. & Mercer, Fraser Gas Co. Inc., Eureka, $159,401; Fredrickson Bros., Emeryville, $177,929; Eaton & Smith, San Francisco, $214,424. Contract awarded to C. W. Peterson, North Hollywood, $148,638.

EL DORADO COUNTY—Between railroad crossing near west city limits and east city limits in Placerville, about 2.1 miles in length to be surfaced with P. M. S. and U. R. B., District III, Route 11, Section Plcr. D. M. J. Ruddy & Son, Modesto, $62,656. Contract awarded to Rice Bros., Inc., Marysville, $57,901.

HUMBOLDT COUNTY—Between one mile south of Scotia Post Office and North Scotia Bridge, about 1.4 miles in length to be graded and surfaced with P. M. S. on C. T. B. and reinforced concrete undercrossing structure to be constructed. District I, Route 1, Section E. L. A. and R. S. Crow, El Monte, $1,086,896.50; Eaton & Smith, San Francisco, $966,-184.65; Ball & Simpson, Berkeley, $903,044.20; Guy F. Atkinson Co., South San Francisco, $892,888.25. Contract awarded to Frederickson Bros., Emeryville, $879,444.40.

LAKE COUNTY—Between 5.2 and 5.5 miles north of Middletown, about 0.3 mile of roadway to be graded, I. B. M. to be placed, and surfaced with R. M. S. District I, Route 89, Section B. O'Connor Bros., Red Bluff, $65,884.60; Britt Pugh, Ukiah, $51,247.10; Louis Biasotti & Son, Stockton, $44,-626.80; Harold Smith, Saint Helena, $39,933.80. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, $37,472.10.

LOS ANGELES COUNTY—On Santa Ana Freeway, between Todd Avenue and 0.2 mile southeasterly of Lakewood Boulevard, about two miles in net length to be graded and surfaced with P. C. C. pavement on cement treated subgrade; interchange roadways, acceleration and deceleration lanes to be surfaced with P. M. S. on untreated rock base; four grade separation structures and a bridge over the Rio Hondo to be constructed to provide a freeway with a six lane divided roadway. District VII, Route 166, Section A. Guy F. Atkinson Co., Long Beach, $2,764,951.35; J. E. Haddock, Ltd., Pasadena, $2,713,870.50; Griffith Co., Los Angeles, $2,660,855.45. Contract awarded to United States Concrete Pipe Corp., Baldwin Park, $2,537,790.25.

MENDOCINO COUNTY—About one and one quarter miles north of Willits, truck scales to be installed and approaches to be constructed thereto. District I, Route 1, Section F. O'Connor Bros., Red Bluff, $35,530; Tom C. Latham, Bakersfield, $33,-745.70; Arthur B. Siri, Inc., Santa Rosa, $33,158; Pike & Hill, Carey Bros. & Bailey, San Rafael, $30,-320. Contract awarded to Harms Bros., Sacramento, $25,467.

MERCED, SAN JOAQUIN, STANISLAUS, NAPA, CONTRA COSTA, AND SANTA CLARA COUNTIES—Various locations, sealing pavement joints, District X. Concrete Pavement Maintenance Co., San Francisco, $42,246. Contract awarded to Dana R. Tyson Co., Sacramento, $38,748.

MODOC COUNTY—Between Toms Creek and Cedarville, about 8.9 miles in length, seal coat to be applied. District II, Route 28, Section C. O'Connor Bros., Red Bluff, $33,575; H. B. Folsom, Westwood, $17,725. Contract awarded to Morgan Construction Co., Redding, $16,550.

MONTEREY COUNTY—Town of seaside, at the intersection of Fremont Street with Broadway, a full traffic-actuated signal system and highway lighting to be furnished and installed and channelization to be constructed. District V, Route 56, Section I. Watsonville Electrical Appliance Co., Inc., Watsonville, $20,906.78; Fischbach & Moore, Inc., Los Angeles, $20,183; Ets-Hokin & Galvan, Monterey, $19,-558; L. H. Leonardi Electric Construction Co., San Rafael, $18,663.60. Contract awarded to Howard Electric Co., Gilroy, $17,962.25.

NEVADA COUNTY—Between Donner Summit and Donner Lake about 0.8 mile in total net length to be graded and surfaced with P. M. S. on untreated rock base. District III, Route 37, Section C. J. Henry Harris, Berkeley, $159,390.50. Contract awarded to Harms Bros., Sacramento, $129,658.50.

NEVADA COUNTY—Between Flycaster's and Mystic, a net distance of about 1.3 miles, roadway to be restored and surfaced with P. M. S. on C. R. B. District III, Route 38, Section A. B. Contract awarded to Harms Bros., Sacramento, $290,976.

ORANGE COUNTY—On Santa Ana Freeway from Broadway to First Street, highway lighting and illuminated sign systems to be furnished and installed. District VII, Routes 2, 174, Sections SA, C, SA. Ets-Hokin & Galvan, Inc., Wilmington, $109,-203; Fischbach & Moore, Inc., Los Angeles, $107,-006; Electric & Machinery Service, Inc., South Gate, $104,563. Contract awarded to Westates Electrical Construction Co., Los Angeles, $102,830.

RIVERSIDE COUNTY—In the City of Corona, between the east city limits and Main Street, a distance of about 2.4 miles, P. M. S. to be placed over existing pavement and portions of the roadbed to be widened with P. M. S. on imported base material. District VIII, Route 77, R. A. Erwin, Colton, $45,-666; Cox Bros. Construction Co., Stanton, $44,021. Contract awarded to E. L. Yeager Co., Riverside, $42,648.30.

SAN BERNARDINO COUNTY—In the City of San Bernardino, on "E" Street between Rialto Avenue and Fifth Street, traffic signal systems and highway lighting to be furnished and installed and modified. District VIII, Routes 43, 9. C. D. Draucker, Inc., Los Angeles, $23,592; Westates Electrical Construction Co., Los Angeles, $21,469; Paul R. Gardner, Ontario, $20,805. Contract awarded to Fischbach & Moore, Inc., Los Angeles, $19,867.

SAN BERNARDINO COUNTY—Between 0.6 mile north of Devore and 0.2 mile south of Cajon Underpass about 9.3 miles to be graded and surfaced with P. M. S. on base material and four reinforced concrete bridges and two culverts to be constructed, to provide a freeway with four lane divided roadbed. District VIII, Route 31, Section B. Ball & Simpson, Erickson Phillips & Weisberg, and San Ramon Valley Land Co., Berkeley, $2,333,445.30; Granite Construction Co., Watsonville, $2,249,136; Chas. MacClosky Co., Geo. Herz & Co., & C. G. Willis & Sons, Inc., San Francisco, $2,248,472.44; L. A. & R. S. Crow, El Monte, $2,223,469; Peter Kiewit Sons Co., Arcadia, $2,193,553.10; J. A. Payton & Bent Const. Co., Los Angeles, $2,066,-949.20. Contract awarded to Fredericksen & Kasler, Sacramento, $2,007,473.60.

SANTA BARBARA COUNTY—Cleaning and painting a bridge over San Roque Canyon in the City of Santa Barbara. District V, Route 80. Timmons Painting & Engineering Co., Long Beach, $19,995.

SANTA BARBARA COUNTY—Between 0.5 mile east of Arroyo Parida and Ortega Hill, about 3.7 miles in length to be graded and paved with P. C. C. on cement treated subgrade, reinforced concrete bridges to be constructed across Arroyo Parida, Arroyo Parida (Frontage Road) and Toro Creek and a reinforced concrete pedestrian undercrossing to be constructed at Hollister Street, District V, Route 2, Sections H, J. United Concrete Pipe Corp., Baldwin Park, $1,203,377; J. E. Haddock, Ltd., Pasadena, $1,192,-047.55; Granite Construction Co., Watsonville, $1,-189,369; Ball & Simpson, Berkeley, $1,112,090.30. Contract awarded to Griffith Co., Los Angeles, $1,023,574.95.

SANTA BARBARA, SAN LUIS OBISPO & MONTEREY COUNTIES—At Salsipuedes Street and between Bath Street and Junipero Street in the City of Santa Barbara; between Cayucos and 0.6 mile north; between Route 33 and Kern County line and between Spence Underpass and 2 miles south of Salinas, about 9.7 miles in length, seal coat to be applied, District V, Routes 2, 56, 125; Sections S.B., C, D, B. J. Henry Harris, Berkeley, $32,032. Contract awarded to Granite Construction Co., Watsonville, $30,042.50.

SANTA CLARA COUNTY—Between Llagas Creek and Gilroy, about 5.6 miles in length, P.M.S. to be placed over existing pavement and new shoulders constructed. District IV, Route 2, Section C. Granite Construction Company, Watsonville, $175,030; A. J. Raisch Paving Co., San Jose, $168,-573.90; M. J. Ruddy & Son, Modesto, $157,226.50. Contract awarded to Fredrickson & Watson Construction Co., Oakland, $154,840.

SANTA CLARA COUNTY—Between south city limits of San Jose and Tully Road, about 1.5 miles to be widened, and surfaced with plant mixed surfacing on the existing pavement and cement treated base. District IV, Route 2, Section B. Leo. F. Piazza Paving Co., San Jose, $100,016.74. Contract awarded to A. J. Raisch Paving Co., San Jose, $99,-802.25.

SHASTA COUNTY—Reroofing of District II Office, Maintenance and Garage Buildings, in Redding, Shasta County. District II. B. W. Harlan, 1646 Tehama Street, Redding, $2,420; contract awarded to C. D. Rich, Redding, $2,313.78.

SISKIYOU COUNTY—At Weed Maintenance Station, a truck shed, gasoline and oil house, pump house, and fence to be constructed, plumbing and electrical facilities to be installed, clearing and grading to be performed and I. B. M. material to be placed. District II, Route 3, Section A. E. F. Myers, Chico, $44,963; A. J. McMurry Co., Yreka, $41,-723; Pike & Hill and Carey Bros., and Bailey, San Rafael, $41,600; Triangle Const. Company, Sacramento, $39,750. Contract awarded to R. Taylor Willis, Napa, $36,949.

SISKIYOU AND SHASTA COUNTIES—Cleaning and painting four bridges at Shasta River eight miles north of Yreka, at Scott River two miles east of Hamburg, at Oak Run Creek 14 miles east of Redding and over Southern Pacific Railroad at Redding. District II, Routes 3, 46, 20. R. W. Reade & Co., Berkeley, $12,852. Contract awarded to J. S. Morris Co., Berkeley, $7,990.

SONOMA COUNTY—Between Purple Draw and 0.9 mile east of Santa Rosa and between Cotati and Sebastopol (portions) about 4.9 miles, additional roadway widths to be graded and plant-mixed surfacing to be placed on existing pavement, cement treated base and crusher run base. District IV, Routes 51, 104, Sections C, SRo, A,C. A. G. Raisch Co., San Rafael, $239,924.70. Contract awarded to Arthur B. Siri, Inc. and F. A. Forde, Santa Rosa, $226,387.55.

VENTURA COUNTY—On Ventura Boulevard, from Santa Clara River Bridge through Montalvo, highway lighting to be furnished and installed. District VII, Route 2, Section C. Fischbach & Moore, Inc., Los Angeles, $8,324; Westates Electrical Const. Co., Los Angeles, $7,944. Contract awarded to Electric & Machinery Service, Inc., South Gate, $7,886.

YUBA COUNTY—City of Marysville, at intersections of Tenth Street with H Street and I Street and Ninth Street with B Street, traffic signal systems and highway lighting to be furnished and installed at 2 intersections and intersection improvement to be constructed at 1 intersection. District III, Routes 3, 15. Hall Sloat Electric Co., Inc., Oakland, $27,-470. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $23,716.

F. A. S. County Routes

KERN COUNTY—On Airport Avenue between State Route 4 and Norris Road, a structural steel railroad underpass to be constructed and about 1.2 miles of 4 lane divided highway to be graded and surfaced with P.M.S. on U.R.B. District VI, Route 881. Ball & Simpson, Berkeley, $422,778.15. Contract awarded to Grifhth Co., Los Angeles, $366,-833.30.

LOS ANGELES COUNTY—Across Rio Hondo on Florence Avenue, a reinforced concrete and structural steel bridge to be constructed. District VII, FAS Route 838. O. B. Pierson, Bellflower, $271,-022; Charles MacClosky Co., San Francisco, $292,-660; K. B. Nicholas, Ontario, $296,286. Contract awarded to E. G. Perham, Los Angeles, $270,478.50.

LOS ANGELES COUNTY—Across Rio Hondo, on Beverly Boulevard, a combination reinforced concrete and structural steel bridge to be constructed. District VII, Route 845. Granite Const. Co., Watsonville, $427,379; K. B. Nicholas, Ontario, $425,-381.70; Chas. MacClosky Co., San Francisco, $393,-738.75. Contract awarded to John Strona, Pomona, $372,510.01.

LOS ANGELES COUNTY—Across San Gabriel River, on Center Street, a reinforced concrete girder bridge to be constructed, District VII, Route 835. E. G. Perham, Los Angeles, $249,446; Granite Construction Co., Watsonville, $248,131; Sharp & Fellows Construction Co., Los Angeles, $234,087.20; Chas. MacClosky Co., San Francisco, $219,128.20; Oberg & Cook, Gardena, $214,780.80; John Strona, Pomona, $214,426.50. Contract awarded to Lars Oberg, Los Angeles, $212,493.20.

LOS ANGELES COUNTY—Across San Gabriel River, on Imperial Highway, a reinforced concrete girder bridge to be constructed. District VII, Route 636. Byerts & Sons and Geo. K. Thatcher, Los Angeles, $250,217. Contract awarded to Charles MacClosky Co., San Francisco, $212,842.

MARIN COUNTY—On Point Reyes Station—Novato Road, between 10 miles east of Point Reyes Station and 6.2 miles west of Novato, about 2.3 miles of roadway to be graded, imported base material to be placed, and surfaced with plant mixed surfacing. District IV, Route 879. Huntington Bros., San Anselmo, $133,656.25; E. A. Forde, San Anselmo, $101,110. Contract awarded to A. G. Raisch Co., San Rafael, $94,692.70.

MONO COUNTY—Between Alpine County line and U. S. 395, portions (about 6 miles north of Coleville) about 4 miles, to be graded and drainage structures to be installed on about 3.6 miles of existing roadbed. District IX, Route 959. Richter Bros., Oroville, $246,317.80; R. P. Shea Co., Indio, $210,473.42; L. A. & R. S. Crow, El Monte, $207,111; M. Malfitano & Son, Inc., Pittsburg, $202,-482.60; Arthur B. Siri, Inc., Santa Rosa, $171,499; T. M. Montgomery, Auburn, $169,368; Eaton & Smith, San Francisco, $150,734.90. Contract awarded to C. V. Kenworthy, Stockton, $146,059.

ORANGE COUNTY — On Wright Brookhurst Street between Wintersburg Avenue and Santa Ana Freeway, about 8.9 miles (portions) to be widened and plant mixed surfacing placed over existing surfacing and new untreated rock base and the remaining portions to be graded and surfaced with plant mixed surfacing on untreated rock base. District VII, Route 747. Roland T. Reynolds, Anaheim, $269,866; M. S. Mecham & Sons, South Gate, $320,-006.50; Vido Kovacevich Co., South Gate, $341,-857.50; Griffith Co., Los Angeles, $349,093.05; Cox Bros. Construction Co., Stanton, $384,164.25. Contract awarded to Sully Miller Contracting Co., Long Beach, $259,694.90.

PLUMAS COUNTY—At Indian Creek Bridge, about 0.8 mile south of Crescent Mills, about 0.6 mile to be graded and surfaced with R.M.S. on C.R.B. and reinforced concrete bridge to be constructed. District II, Route 1062. O'Connor Bros., Red Bluff, $190,184.90; Chittenden & Crittenden & B. S. McElderry, Auburn, $181,019.50. Contract awarded to M. A. Jenkins & R. E. Hertel, Sacramento, $177,903.

RIVERSIDE COUNTY—Across Santa Ana River, on Crestmore Road, near Riverside, a steel plate girder bridge to be constructed. District VIII, Route 1177. E. L. Yeager Co., Riverside, $345,214.50; Ralph A. Bell, Monrovia, $309,809.10; Chas. MacClosky Co., San Francisco, $296,792; K. B. Nicholas, Ontario, $289,900; Judson Pacific-Murphy Corp., Emeryville, $289,280; O. B. Pierson, Bellflower, $273,472. Contract awarded to C. B. Tuttle Co., Long Beach, $266,184.

SACRAMENTO COUNTY—On Greenback Lane, between Main Avenue, in Orangevale Colony and Folsom-Auburn Road, about 1.5 miles of roadway to be graded, imported subbase material and untreated rock base to be placed and surfaced with P.M.S. District III, Route 928. C. V. Kenworthy, Stockton, $212,941; San Ramon Valley Land Co., Berkeley, $185,940.40; Harms Bros. & M. W. Brown, Sacramento, $180,473; Brighton Sand & Gravel Co., Sacramento, $170,734; Louis Biasotti & Son, Stockton, $163,730.50; A. Teichert & Son, Inc., Sacramento, $160,390. Contract awarded to J. R. Reeves, Sacramento, $149,386.

SACRAMENTO COUNTY — Portions between S.P.R.R., near Walnut Grove, and Mokelumne River and between Locke and Franklin Boulevard, about 7.7 miles in length; Portion A, to be graded, imported subbase material and crusher run base to be placed and surfaced with P.M.S.; and Portion B to be surfaced with P.M.S. District III, Routes 900 and 539. McGillivray Construction Co., Sacramento, $163,253.50; A. Teichert & Son, Inc., Sacramento, $159,606; Claude C. Wood Co., Lodi, $151,127.95. Contract awarded to Brighton Sand & Gravel Co., Sacramento, $147,359.50.

SACRAMENTO COUNTY—On El Centro Road, between Elkhorn Road and Elverta Road about 2 miles of roadway to be graded, imported subbase material and crusher run base to be placed, and surfaced with armor coat. District III, Route 926. Louis Biasotti & Son, Stockton, $119,120.50; L. G. Lentz, Sacramento, $111,065.75; A. Teichert & Son, Inc., Sacramento, $108,802. Contract awarded to Brighton Sand & Gravel Co., Sacramento, $100,-732.55.

SAN BERNARDINO COUNTY—On Sierra Avenue, between Valley Freeway and Highland Avenue, about 4.7 miles to be graded to provide additional width and surfaced with P.M.S. on cement treated base and on existing pavement. District VIII, Route 705. R. A. Erwin, Colton, $241,-878.50; A. S. Hubbs and Hubbs Equipment Co., Colton, $234,131; Vernon Paving Co., Los Angeles, $224,934.50; E. L. Yeager Co., Riverside, $216,-926.75; George Herz & Co., San Bernardino, $204,-407.85. Contract awarded to Matich Bros. Paving Co., Colton, $193,703.

SANTA CLARA COUNTY—On San Jose Stevens Creek Road, between Bascom Avenue and Saratoga Avenue, about 2.2 miles, to be graded and surfaced with P.M.S. on I.B.M. District IV, Route 1000. Edward Keeble, San Jose, $240,246; Leo F. Piazza Paving Co., San Jose, $223,249.34. Contract awarded to A. J. Raisch Paving Co., San Jose, $222,264.55.

SANTA CRUZ AND SANTA CLARA COUNTIES—On Summit Road, between State Highway Route 5 and Woodwardia, about 1.3 miles, to be graded, surfaced with crusher run base and prime coat and seal coat to be applied. District IV, Route 616. Louis Biasotti & Son, Stockton, $145,965.50; Elmer J. Warner, Stockton, $145,072.50; Guerin & Morgan, Los Gatos, $127,931; Eaton & Smith, San Francisco, $125,354; Edward Keeble, San Jose, $113,-158. Contract awarded to Granite Construction Co., Watsonville, $109,483.

SIERRA COUNTY—Between 5.2 miles and 0.5 mile west of Loyalton, portions about 3.4 miles of roadway to be graded, I.B.M. to be placed and treated with lime, and penetration treatment to be applied. District III, Route 524. O'Connor Bros., Red Bluff, $137,457.40; Louis Biasotti & Son, Stockton, $123,772.90; Britt Pugh, Ukiah, $109,685.90; Lefever & Bing, West Sacramento, $107,416; C. W. Peterson, North Hollywood, $88,979.60. Contract awarded to Joe Chevreaux, Auburn, $76,172.

SONOMA COUNTY—On Petaluma-Valley Ford Highway between 1.0 mile easterly and 1.7 miles westerly of Valley Ford, about 19 miles west of Petaluma, about 2.7 miles to be graded and surfaced with I.B.M. on imported subbase material and surfaced with I.B.M. on imported subbase material and Class "B" Double sl. ct. and penetration treatment applied. District IV, Route 777. Arthur B. Siri, Inc., Santa Rosa, $193,388.50. Contract awarded to Pike & Hill and Carey Bros. and Bailey, San Rafael, $176.641.25.

STANISLAUS COUNTY—On McHenry Avenue between State Highway Route 13 and San Joaquin County line, about 1.7 miles, to be surfaced with P.M.S. on U.R.B. District X, Route 903. United Concrete Pipe Corporation, Baldwin Park, $41,-202.50; Standard Materials, Incorporated, Modesto, $39,590. Contract awarded to M. J. Ruddy & Son, Modesto, $37,619.75.

VENTURA COUNTY—Across Santa Clara River at Santa Paula, a structural steel and reinforced concrete bridge to be constructed and about ¼ mile of approaches to be graded and surfaced with plant-mixed surfacing on untreated rock base. District VII, Route 876. K. B. Nicholas, Ontario, $417,423; C. B. Tuttle Co., Long Beach, $428,826.60; Chas. MacClosky Co., San Francisco, $439,627.86; Granite Construction Co., Watsonville, $443,874; Judson Pacific-Murphy Corp., Emeryville, $443,966.50; Ralph A. Bell, Monrovia, $449,484; Norman I. Fadel, North Hollywood, $536,694.30. Contract awarded to O. B. Pierson, Bellflower, $397,890.75.

YOLO COUNTY—Between County Road 29 and County Road 27, about 6 miles south of Woodland, about 2 miles, the existing roadbed to be surfaced with P.M.S. on U.R.B. and penetration treatment applied to shoulders and road approaches. District III, Route 1167. A. Teichert & Son, Inc., Sacramento, $82,030. Contract awarded to W. C. Railing, Woodland, $69,825.

September, 1951

ALAMEDA COUNTY—In the City of San Leandro at the intersection of MacArthur Boulevard and Dutton Avenue, traffic signal system and highway lighting to be furnished and installed and drainage improvement to be constructed. District IV, Route 5. L. H. Leonardi Electric Construction Co., San Rafael, $12,939 Scott-Buttner Electric Co., Inc., Oakland, $13,373; Hall Sloat Electric Co., Inc., Oakland, $13,472. Contract awarded to R. Flatland, San Francisco, $12,456.

CONTRA COSTA COUNTY—At Franklin Creek near Glen Frazer, about 0.3 mile to be graded and surfaced with plant mixed surfacing on crusher run base and imported subbase material and seal coats applied. District IV, Route 106, Section A. Lee J. Immel, San Pablo, $32,198; J. Henry Harris, Berkeley, $38,663. Contract awarded to Eugene G. Alves, Pittsburg, $29,293.20.

FRESNO COUNTY—At intersection of U. S. 99 with Central Avenue and with Chestnut Avenue, furnishing and installing highway lighting system. District IV, Route 4, Section B. Robinson Electric, Fresno, $4,340; McCrory Electric, Fresno, $4,718; Westates Electrical Construction Co., Los Angeles, $5,048. Contract awarded to Dale Electric Co., Fresno, $4,220.

FRESNO COUNTY—Across Big Dry Creek about 12 miles east of Academy, an existing combination timber trestle and reinforced concrete bridge to be widened. District VI, Route 76, Section B. Thomas Construction Co., Fresno, $13,961. Contract awarded to Volpa Bros., Fresno, $11,652.50.

KERN COUNTY—In East Bakersfield at intersection of Niles Street and Mt. Vernon Avenue, furnishing and installing traffic signal system and highway lighting. District VI, Route 57, Section E. Fischbach & Moore, Inc., Los Angeles, $12,793. Contract awarded to Westates Electrical Construction Co., Los Angeles, $12,124.

KERN COUNTY—Across East Side Canal, 0.8 mile east of Buttonwillow, a reinforced concrete bridge to be constructed and approaches thereto to be graded and surfaced with plant mixed surfacing on untreated rock base. District VI, Route 58, Section K. Dicco, Inc., Bakersfield, $23,103; Ted Schwartz, Grass Valley, $29,086. Contract awarded to Thomas Construction Co., Fresno, $21,176.50.

LOS ANGELES COUNTY—On Ramona Freeway between Eighth Street and 0.1 mile east of Jackson Avenue, about 1.7 miles to be graded and paved with Portland cement concrete on cement treated subgrade and with plant-mixed surfacing on imported base material and four bridges and a pedestrian undercrossing to be constructed, to provide a six lane divided highway with frontage roads. District VII, Route 26, Sections Alh, MonP, E. J. L. Haddock, Ltd., Pasadena, $2,517,882; United Concrete Pipe Corp., Baldwin Park, $2,628,920. Contract awarded to Griffith Co., Los Angeles, $2,381,815.10.

LOS ANGELES COUNTY—Between Palmdale and 2 miles east of Llano, about 3.5 miles to be graded and bituminous surface treatment applied and a reinforced concrete girder bridge to be constructed. District VII, Route 59, Sections H, I, J. Lowe & Watson and Lloyd R. Johnson, San Bernardino, $187,960; Jesse S. Smith and Service Construction Co. of Southern California, Burbank, $190,265; Dimmitt & Taylor, Monrovia, $190,598; L. A. & R. S. Crow, El Monte, $192,299; E. C. Young, San Fernando, $195,041; R. M. Price Co., Altadena, $198,381; A. S. Hubbs and Hubbs Equipment Co., Colton, $198,888; R. P. Shea Co., Indio, $209,313; E. L. Yeager Co., Riverside, $213,837; Roland T. Reynolds, and Thomas Construction Co., Anaheim, $214,340; Ralph A. Bell, Monrovia, $218,335; Matich Bros., Colton, $228,572; G. W. Ellis Construction Co., North Hollywood, $243,824. Contract awarded to Osborn Co., Pasadena, $187,907.50.

MARIN COUNTY—Between Myrtle Avenue in San Rafael and California Park Overhead, about 2 miles, highway ramps, a frontage road and highway roadbeds to be constructed, plant mixed surfacing to be placed, an existing reinforced concrete bridge to be widened, a reinforced concrete bridge to be constructed and highway lighting facilities to be installed. District IV, Route 1. Granite Construction Co., Watsonville, $1,097,103; Guy F. Atkinson Co., South San Francisco, $1,189,990; Chas. L. Harney, Inc., San Francisco, $1,248,285; Eaton & Smith and Clements & Co., San Francisco, $1,248,796. Contract awarded to A. G. Raisch Co. and Lew Jones Construction Co., San Rafael, $1,056,885.25.

MARIN COUNTY—Between 0.6 mile north of Alto Intersection and Waldo, portions about 1.4 miles in length, placing plant-mixed surfacing on the existing pavement and cement treated base, constructing shoulders of crusher run base and applying seal coat. District IV, Routes 1, 56, Sections C, D, A. Brown-Ely Co., Contractors, Corte Madera, $202,790; A. G. Raisch Co., San Rafael, $205,692; Chas. L. Harney, Inc., San Francisco, $209,083. Contract awarded to Granite Construction Co., Watsonville, $192,282.

MONTEREY COUNTY — Across Burns Creek about 46 miles south of Monterey, an existing steel plate girder and steel truss bridge to be cleaned and painted. District V, Route 56, Section D. Contract awarded to R. W. Reade & Co., Berkeley, $19,844.

NAPA COUNTY—Between Lake County line and 1.5 miles north of Calistoga, about 7.2 miles to be surfaced with plant-mixed surfacing on untreated rock base. District IV, Route 49, Section A. Granite Construction Co., Watsonville, $227,408; M. J. Ruddy & Son, Modesto, $231,849; Mercer Fraser Co., Inc. & Mercer Fraser Gas Co., Inc., Eureka, $239,-710. Contract awarded to Munn & Perkins, Modesto, $225,119.50.

ORANGE COUNTY—On Stanton Avenue between Garden Grove Avenue and Lincoln Avenue, about 4 miles, a new two-lane roadway to be graded and surfaced with plant-mixed surfacing on untreated rock base over imported subbase material; the existing roadbed to be widened and surfaced with plant-mixed surfacing on existing pavement and on untreated rock base; and seal coats to be applied to provide a four-lane divided highway. District VII, Route 171, Section B. M. S. Mecham & Sons, South Gate, $485,822; Sully-Miller Contracting Co., Long Beach, $487,955. Contract awarded to Roland T. Reynolds, Anaheim, $411,268.

SACRAMENTO COUNTY—At the intersections of Fulton Avenue with Arden Way and with El Camino Avenue, full traffic-actuated signal systems and highway lighting to be furnished and installed and Portland cement concrete curb to be constructed. District III, Route 98, Section A. Grason Electric Co., Sacramento, $24,298; L. H. Leonardi Electric Construction Co., San Rafael, $24,577. Contract awarded to R. Goold & Son, Stockton, $23,298.

SAN BERNARDINO COUNTY—City of Ontario, on A Street at Bon View Avenue and on Euclid Avenue at B Street, traffic signals and highway lighting to be furnished and installed. District VIII, Routes 26, 192. Paul R. Gardner, Ontario, $11,128; Fischbach & Moore, Inc., Los Angeles, $11,149; Westates Electrical Construction Co., Los Angeles, $12,119; Schurr & Finlay, Inc., Los Angeles, $18,260. Contract awarded to Electric & Machinery Service, Inc., South Gate, $10,873.

SAN DIEGO COUNTY—Between Buena Vista Lagoon and ¼ mile south of Mission Avenue in Oceanside, about 2.1 miles to be graded and paved with Portland cement concrete and a reinforced concrete bridge and grade separation structures to be constructed. District XI, Route 2, Section B, Ocn. Griffith Co., Los Angeles, $1,649,703; Cox Bros. Construction Co., Stanton, $1,655,528; United Concrete Pipe Corp., Baldwin Park, $1,725,398; J. A. Thompson & Son and Webb & White, Inglewood, $1,729,140; Guy F. Atkinson Co., Long Beach, $1,796,232; Clyde W. Wood & Sons, Inc., Chas. MacClosky Co. and R. E. Hazard Contracting Co., San Francisco, $1,811,811; Daley Corp., San Diego, $1,886,384. Contract awarded to J. A. Payton and Bent Construction Co., Los Angeles, $1,618,804.95.

SAN JOAQUIN COUNTY—Over the tracks of the Southern Pacific Co. at Tracy, across Paradise Cut (westbound) and across San Joaquin River at Mossdale (westbound), three steel bridges to be cleaned and painted. District X, Route 5, Sections A, B. D. E. Burgess Co., San Francisco, $30,356; H. C. McKern, San Jose, $37,310. Contract awarded to J. S. Morris Co., Berkeley, $22,945.

SAN LUIS OBISPO COUNTY—In the City of San Luis Obispo, at Santa Rosa Street, at Ida Street and at the Southern Pacific Railroad, two reinforced concrete bridges and an underpass to be constructed and streets to be graded and one street to be surfaced with plant-mixed surfacing on cement treated imported base material. District V, Route 2. Erickson, Phillips & Weisberg, Oakland, $554,212; Fredrickson & Watson Construction Co., Oakland, $581,367; Charles MacClosky Co. and Madonna Construction Co., San Francisco, $598,619. Contract awarded to Granite Construction Co., Watsonville, $529,169.

SAN LUIS OBISPO COUNTY—At the intersections of Spring Street with 12th Street and 13th Street in the City of Paso Robles, semitraffic-actuated signal systems and highway lighting to be furnished and installed at two intersections. District V, Routes 2, 33. Fischbach & Moore, Inc., Los Angeles, $16,-441; Ets-Hokin & Galvan, Monterey, $17,311; L. H. Leonardi Electric Construction Co., San Rafael, $17,455; A C Electric Co., Bakersfield, $17,965. Contract awarded to Howard Electric Co., Gilroy, $15,735.

SAN LUIS OBISPO COUNTY—Across Arroyo De La Cruz about 8.5 miles north of San Simeon, a timber trestle bridge to be redecked with a reinforced concrete slab. District V, Route 56, Section A. Ted Schwartz, Grass Valley, $26,902; B. S. McElderry, Berkeley, $27,809; James H. McFarland, San Francisco, $33,962; Laredon Construction Co., Los Angeles, $34,222. Contract awarded to Wm. Radtke & Son, Gilroy, $25,074.

SANTA BARBARA COUNTY—In the City of Santa Barbara between Montecito Separation and Park Place, about 0.5 mile additional widths to be graded and surfaced with plant-mixed surfacing on untreated rock base. District V, Route 2. Griffith Co., Los Angeles, $34,382. Contract awarded to Baker & Pollock, Ventura, $30,335.55.

SOLANO COUNTY—Between Cordelia Underpass and Ledgewood Creek, highway lighting and illuminated sign systems to be furnished and installed. District X, Routes 7, 8, Sections H, B, A. L. H. Leonardi Electric Construction Co., San Rafael, $22,607. Contract awarded to Underground Electric Construction Co., Oakland, $21,800.

F. A. S. County Routes

CALAVERAS COUNTY—Between 5.3 and 9.7 miles north of Mountain Ranch, about 4.4 miles, to be graded, imported subbase material to be furnished and placed and penetration treatment to be applied. District X, Route 953. M. Malfitano & Son, Inc., Pittsburg, $93,699; Lefever & Bing, West Sacramento, $123,916; Richter Bros., Oroville, $128,962. Contract awarded to Claude C. Wood Co., Lodi, $84,768.20.

FRESNO COUNTY—On Fresno-Coalinga Road, between Coalinga-Mendota Road and Ford Avenue, about 3.9 miles to be graded, imported base material to be placed and cement treatment and bituminous surface treatment to be applied. District VI, Route 809. Vega Engineering & Grading Co., Berkeley, $152,350; Gerald F. Brewster, Avenal, $167,366; John Delphia, Patterson, $171,987; M. J. Ruddy & Son, Modesto, $189,229; Vinnell Co., Inc., Alhambra, $191,024; T. M. Montgomery, Auburn, $199,-836; Folsom & Folsom, Coalinga, $200,587; L. A. & R. S. Crow, El Monte, $203,853; Valley Paving & Construction Co., Inc., Pismo Beach, $217,212; R. P. Shea Co., Indio, $219,351; Close Building Supply, Inc., Hayward, $224,921. Contract awarded to Louis Biasotti & Son, Stockton, $140,152.40.

MERCED COUNTY—On Santa Fe Drive between Stanislaus County line and El Capitan Way, about 5.9 miles, to be graded and surfaced with road-mixed surfacing on untreated rock base. District X, Route 912. Standard Materials, Inc., Modesto, $83,457; T. M. Montgomery, Auburn, $83,973; Lefever & Bing, West Sacramento, $85,000; United Concrete Pipe Corp., Baldwin Park, $93,410; M. Malfitano & Son, Inc., Pittsburg, $95,651; M. J. Ruddy & Son, Modesto, $100,864; Munn & Perkins, Modesto, $107,182. Contract awarded to Baun Construction Co., Fresno, $79,254.

MONO COUNTY—Across West Walker River, near Coleville, a steel girder bridge with reinforced concrete deck to be constructed. District IX, Route 1094. Eaton & Smith, San Francisco, $71,861; R. P. Shea Company, Indio, $83,535; Nomellini Construction Co., Stockton, $84,865. Contract awarded to E. H. Peterson & Son, San Pablo, $58,800.

NAPA COUNTY—On Silverado Trail, between Skellenger Lane and State Highway Route 102, about 1.9 miles, imported base material to be placed and bituminous surface treatment applied. District IV, Route 607. Harold Smith, Napa, $46,896; J. Henry Harris, Berkeley, $50,218. Contract awarded to E. A. Forde, San Anselmo, $43,871.

NAPA COUNTY—Imola Avenue West, between Napa State Hospital and 1.3 miles west, about 1.3 miles to be surfaced with plant-mixed surfacing on existing and new crusher run base. District IV, Route 776. A. G. Raisch Co., San Rafael, $33,325; J. Henry Harris, Berkeley, $36,539; Slinsen Construction Co., Napa, $36,949. Contract awarded to E. A. Forde, San Anselmo, $31,155.

SAN JOAQUIN COUNTY—On Pacific Avenue, between F. A. S. Route 641 near the Five Mile House northwest of Stockton and Stockton city limits about 2.7 miles, existing pavement to be widened with untreated rock base, a four-lane highway to be graded and surfaced with untreated rock base on imported base material, penetration treatment and seal coat to be applied, a new bridge to be constructed and the railing of an existing bridge to be removed and new railing to be constructed. District X, Route 543. Nomellini Construction Co., Stockton, $168,-076; Louis Biasotti & Son, Stockton, $178,597; M.J.B. Construction Co., Stockton, $182,381. Contract awarded to George Pollock Co., Sacramento, $159,188.

SANTA CRUZ COUNTY—On Watsonville-Santa Cruz Road between Freedom and Watsonville, about 1.1 miles to be graded and plant-mixed surfacing and seal coats to be placed. District IV, Route 1146. Leo F. Piazza Paving Co., San Jose, $101,366; Edward Keeble, San Jose, $101,858; Louis Biasotti & Son, Stockton, $122,025. Contract awarded to Granite Construction Co., Watsonville, $93,945.

SUTTER COUNTY—Between 1 mile south of Striplin Road and Striplin Road, about 1.1 miles to be graded, surfaced with lime treated imported base material and a penetration treatment and a seal coat applied. District III, Route 926. McGillivray Construction Co., Sacramento, $66,788; A. Teichert & Son, Inc., Sacramento, $73,509; O'Connor Bros., Red Bluff, $83,130. Contract awarded to P. J. Moore & Son, Tracy, $59,136.70.

TULARE COUNTY—About ¼ mile south of Porterville, across Tule River and Poplar Ditch, a reinforced concrete bridge to be constructed. District VI, Route 1127. C. K. Moseman, Redwood City, $182,738; C. B. Tuttle Co., Long Beach, $183,636; O. B. Pierson, Bellflower, $183,690; Charles MacClosky Co., San Francisco, $193,891; Thomas Construction Co., Fresno, $195,279; E. S. & N. S. Johnson, Fullerton, $205,096; Tumblin Company, Bakersfield, $216,953; Nomellini Construction Co., Stockton, $237,313. Contract awarded to Trewhitt, Shields & Fisher, Fresno, $180,618.80.

SERVICE AWARD CERTIFICATES PRESENTED EMPLOYEES

Officials of Public Works Department and recipients of service award certificates. FIRST ROW, LEFT TO RIGHT: Alfred Eichler, George Glacken, Earl Hampton, Carl Henderlong, George Kneppler. SECOND ROW—Walter J. Long, D. Harold McMillan, P. T. Poage, Moe Sullivan, Albert Strubinger, Oscar Vehn, W. B. Warren, D. C. Willett. THIRD ROW—Wes K. Daniels, Director of Public Works Frank B. Durkee, State Architect Anson Boyd, H. S. Hunter.

Sixteen employees of the Division of Architecture who have been in state service for 25 years and more were presented with Service Award certificates at a ceremony held in the board room of the Department of Public Works on September 27th and attended by Director of Public Works Frank B. Durkee and State Architect Anson Boyd.

The awards were the first to be presented in the Department of Public Works. Similar ceremonies will be held by the Division of Highways and Division of Water Resources. The 25-year service awards were authorized by the Legislature. Two employees, Frank Austgen and Harold F. J. Woodhams, in the Los Angeles office of the division later were given certificates.

The first certificate was handed to Wes K. Daniels, Assistant State Architect, Administrative, with 35 years of service, by Hubert S. Hunter, Deputy Chief of the division. Daniels in turn presented awards to the following:

Recipients	Years
Alfred Eichler, Staff Architectural Designer	25
George Glacken, Office Assistant to Assistant State Architect	27
Earl Hampton, Supervisor, Contract Architects	28
Carl Henderlong, Principal Mechanical and Electrical Engineer	36
George Kneppler, Carpenter Foreman	30
Walter J. Long, Senior Structural Engineer	31
D. Harold McMillan, Structural Engineer Associate	35
Carleton Pierson, Supervising Contract Writer	39
P. T. Poage, Assistant State Architect, Design and Planning	29
Leslie O. Shannon, Plumber	28
Mae Sullivan, Secretary to State Architect	28
Albert Strubinger, Senior Architectural Draftsman	30
Oscar Vehn, Electrician	25
W. B. Warren, Carpenter Foreman	31
D. C. Willett, Chief Construction Engineer	31

In San Diego

Continued from page 38 . . .

The new structure, a high-level crossing, consists of a three-span bridge totaling 455 feet in length, with a roadway width of 28 feet, curb to curb, and a one-foot, nine-inch sidewalk on each side, and will be on the permanent alignment, with temporary connections to the present road at either end.

The work is being supervised by the Bridge Department, with F. B. Donovan as Resident Engineer.

TURKISH ENGINEER STUDIES OUR HIGHWAY CONSTRUCTION

Great changes brought about by the Marshall Plan upon highway construction methods in his homeland were described by a young Turkish engineer here on a one-year course of study of American highways made possible through arrangements between the Turkish Government and the United States. He has been in California two months under tutelage of the Division of Highways.

Fethi Komurcuoglu, who admits that his last name is a bit of a mouthful even in the Turkish language, said that until the end of World War II highway construction methods in Turkey remained slow and primitive. Excavation was done by pick and shovel and the dirt was transported by donkey back or hand cars pushed along small-gauge tracks.

"However," Fethi said, "the Marshall Plan began to change things in a hurry. We received shiploads of modern, American-made equipment, and groups of American highway engineers arrived in Turkey to take up positions as teachers and advisers."

Use American Equipment

Fethi explained that the impact upon the highway setup in Turkey was great. During the past four years the internal organization of the highway department has been completely revamped and streamlined to conform with American models. An up-to-date laboratory for testing materials has been constructed and is already under operation. Not only the Turkish Highway Department but even private contractors are now using the latest American equipment.

"The whole idea of modern construction is new in my country," Fethi continued. "Our equipment operators and mechanics need more experience. Turkish engineers don't have trouble with the theories of engineering, but they lack practical experience. My job in the United States has been to study the working methods employed by your highway personnel. In this respect my experience here has been invaluable."

FETHI KOMURENOGLU

Fethi said that since the war a nine-year highway construction program has been inaugurated in his country which will entail the building of 14,300 miles of two-lane roads throughout Turkey. About one-third of these will be paved with asphalt. When completed they will form the backbone of the whole Turkish Highway System.

After his arrival in the United States in October of last year, Fethi spent a month in Washington, D. C., with the U. S. Bureau of Public Roads, which agency is supervising the training program for highway students sent by foreign governments. Subsequently he spent eight months with the Arizona Highway Department. In July of this year he came to spend two months studying highway construction methods in California.

Fethi said that he found the traffic and financial problems in Arizona similar to those in Turkey; but that as far as climate, geographical conditions and types of soil are concerned, California comes much closer to matching those of his own country.

Has Engineering Record

In spite of his youth, Fethi already has an impressive engineering record. After obtaining his master's degree in civil engineering from the Technical University of Istanbul in 1943, he took a job as a superintendent of construction for a private contractor. He served two years with the Corps of Engineers in the Turkish Army, after which he was appointed to a position with the Directorate-General of Turkish Highways.

Between 1947 and 1950, he was in charge of construction, first of the Ankara-Konya Road and then of the Feyzi Pasa-Narli Road which is a part of the Iskenderon-Erzurum Highway. This highway and the spectacular and hazardous mountain country through which it was built formed part of an article on Turkey in a recent issue of the National Geographic Magazine.

Holds High Post

Just before leaving for the United States to carry on his studies, he was appointed to a post as Divisional Construction and Maintenance Engineer.

Fethi, who will soon leave Sacramento for Washington, D. C., where he will spend a month winding up his studies before returning to his homeland sometime in October, said that he was deeply impressed by the friendliness of the American people.

He said that employees in the U. S. Bureau of Public Roads as well as Highway Departments of both Arizona and California had gone out of their way to make his stay a pleasant one.

APPRECIATION

Palmdale, California

California Highways and Public Works
Sacramento

Gentlemen: Just an expression of appreciation for your fine magazine. It is read and enjoyed by all the family and our guests. We are very grateful to be on your mailing list.

Most sincerely,

Mr. and Mrs. John B. Sigrist
Rt. 3, Box 122
Palmdale, California

Siskiyou Job

Continued from page 6 . . .

wide. This eliminates the congestion caused by the many slow-moving trucks which in the past were a serious restriction to safe traffic flow on the previous winding alignment and steep gradients.

The old road constructed in 1923 by the Henry J. Kaiser Company was a concrete pavement 18 feet in width with shoulders five feet wide on each side. The new overhead at Black Butte, providing a separation of railroad and highway grades, replaces the old narrow structure which had sharp approach curves. The old alignment had 36 curves, whereas the new section has only nine and is 0.37 mile shorter.

After the symbolic ribbon cutting, the group adjourned to the Fawn Club for a buffet supper.

Collier Speaks

Senator Collier gave a short talk which emphasized the gratification that Siskiyou County felt in having this project completed. He pointed out the local benefits besides those to interstate traffic. He also pointed out the needs of the county as reflected against current available funds and said that at the present rate it would require 33 years to meet the county's deficiencies. He voiced the hope for a billion-dollar highway bond issue in 1952 to be retired by additional gas tax revenues.

Other speakers included Principal Highway Engineer J. P. Murphy, representing State Highway Engineer George T. McCoy; and J. W. Trask, District Engineer, who spoke about progress on other pending projects in the county, particularly from Dunsmuir north. Several citizens from other communities spoke as well as representatives from Weed and Mount Shasta. The speakers from these two towns particularly gave favorable mention to Ellis Engle, Resident Engineer; A. A. Bigelow, in charge of paving, and other engineers connected with the work.

Both the Harms and Rand contracts were completed under District Engineer Trask. Ralph Twaddle was Resident Engineer on the Harms contract and Engle was Resident Engineer on the Rand contract. The writer was District Construction Engineer on the entire project.

Realigned section of U. S. 99, looking south towards Black Butte

Footpath to Freeway

Continued from page 4 . . .

Realizing the need for improvement, surveys were undertaken in 1939 for a study of possible relocation within the town of Dunsmuir and in 1945 a survey was made north to Big Canyon for relocation of that portion of highway. The 1945 survey was conducted to explore the feasibility of minor revisions using the basic alignment of the present highway.

It was found that any revision along the present road could only retain many of the faults of the existing highway, so a new survey was made in 1947 by-passing to the east as much as possible of the present highway and developed area from the Sacramento River Bridge northward.

Four Lane Highway and Bridge

The design being completed will provide a four-lane bridge and highway to Mott, approximately one mile south of Big Canyon, and will eliminate the two right-angle turns at the south approach to the Sacramento River bridge. From Mott to Big Canyon the highway will follow new alignment providing a 24-foot traveled way with 8-foot-wide surfaced shoulders.

The existing highway from the Sacramento River Bridge through the developed area for approximately one mile will, with some revision and improvement immediately north of the bridge, be utilized for an outer highway. From the north end of the bridge to Big Canyon the new route has been established as a freeway. The maximum grade on the new construction will be 5 percent and the number of curves will be reduced to eight, all of which have a radius of 1,000 feet or more.

This reconstruction is only the first step in a vast project aimed to bring our Pacific Highway through Shasta ond Siskiyou Counties abreast of present-day standards. The district is still faced with the problem of relieving congestion through Dunsmuir itself and reconstruction of some 26 miles of outmoded highway between Dunsmuir and the upper reaches of Shasta Lake, where the rood twists and turns as it follows along the wolls of the Sacramento Canyon. Vast as it is, the entire project cannot be too long delayed, for traffic on our highways is increasing daily, and no one can safely predict when a peak will be reached.

EARL WARREN
Governor of California

•

FRANK B. DURKEE
Director of Public Works

•

HIGHWAY COMMISSION

HARRISON R. BAKER . . . . Pasadena
HOMER P. BROWN . . . . Placerville
JAMES A. GUTHRIE . . . . San Bernardino
F. WALTER SANDELIN . . . . Ukiah
CHESTER H. WARLOW . . . . Fresno
CHARLES T. LEIGH . . . . San Diego
R. C. KENNEDY, Secretary . . . . . Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY . . . . . . State Highway Engineer
R. M. GILLIS . . . . Deputy State Highway Engineer
CHAS. E. WAITE . . Assistant State Highway Engineer
EARL WITHYCOMBE . Assistant State Highway Engineer
F. W. PANHORST . . Assistant State Highway Engineer
J. W. VICKREY . . Assistant State Highway Engineer
R. H. WILSON . . . Assistant State Highway Engineer
F. N. HVEEM . . . Materials and Research Engineer
GEORGE F. HELLESOE . . . . Maintenance Engineer
E. T. TELFORD . . . . Engineer of Design
DON G. EVANS . . . . Construction Engineer
H. B. LA FORGE . Engineer of Federal Secondary Roads
L. V. CAMPBELL . Engineer of City and Cooperative Projects
EARL E. SORENSON . . . . . . Equipment Engineer
H. C. McCARTY . . . . Office Engineer
J. C. YOUNG . . . . Traffic Engineer
J. C. WOMACK . . . . Planning Engineer
J. P. MURPHY . . . . Principal Highway Engineer
E. J. SALDINE . . . . Principal Highway Engineer
I. O. JAHLSTROM . . . . Principal Bridge Engineer
STEWART MITCHELL . . . Principal Bridge Engineer
E. R. HIGGINS . . . . Comptroller

Right of Way Department

FRANK C. BALFOUR . . . Chief Right of Way Agent
E. F. WAGNER . . . Deputy Chief Right of Way Agent
GEORGE S. PINGRY . . . . Assistant Chief
R. S. J. PIANEZZI . . . . Assistant Chief
E. M. MacDONALD . . . . Assistant Chief

District IV

JNO. H. SKEGGS . . Assistant State Highway Engineer

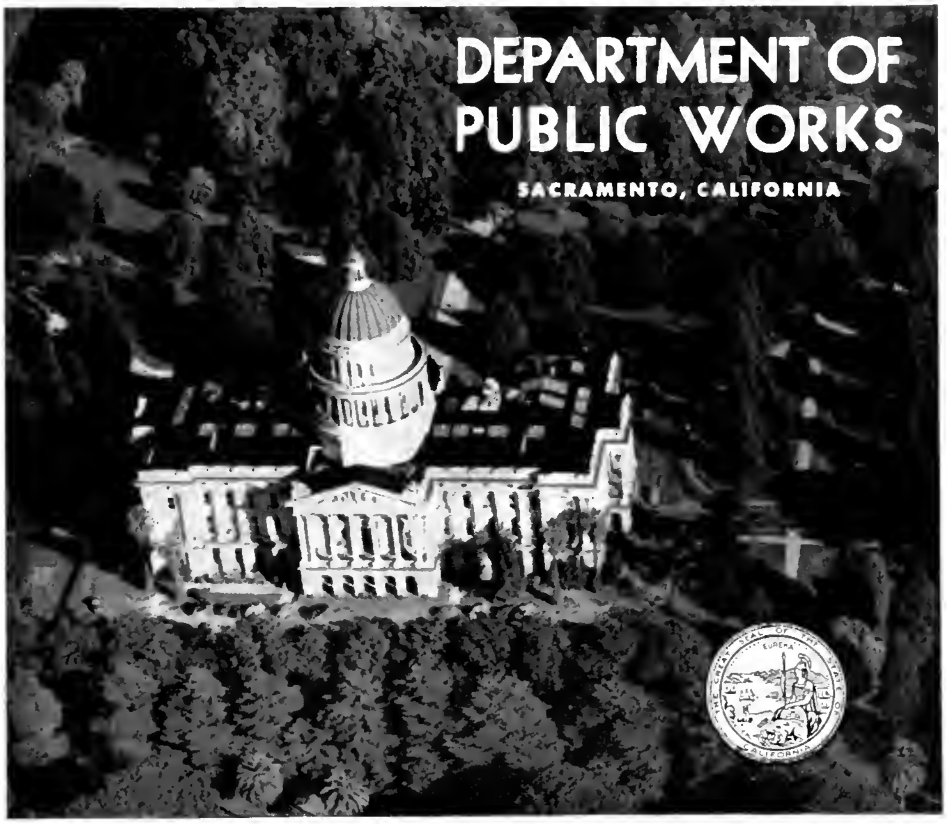
District VII

P. O. HARDING . . Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH . . . . District I, Eureka
J. W. TRASK . . . . District II, Redding
CHARLES H. WHITMORE . . . District III, Marysville
B. W. BOOKER . . . . . . District IV, San Francisco
L. A. WEYMOUTH . . . . District IV, San Francisco
E. J. L. PETERSON . . . . District V, San Luis Obispo
E. T. SCOTT . . . . District VI, Fresno
W. L. FAHEY . . . . . . District VII, Los Angeles
M. E. CESSNA . . . . . . District VII, Los Angeles
S. W. LOWDEN . . . . District VIII, San Bernardino
ALAN S. HART . . . . District IX, Bishop
JOHN G. MEYER . . . . District X, Stockton
E. E. WALLACE . . . . District XI, San Diego
HOWARD C. WOOD . . Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge



DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED . . . . Chief
GEORGE C. HADLEY . . . . Attorney
HOLLOWAY JONES . . . . Attorney

DIVISION OF SAN FRANCISCO TOLL CROSSINGS

NORMAN C. RAAB . . . . Project Design Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON . . State Engineer, Chief of Division
W. H. HOLMES
Principal Engineer, Design and Construction of Dams
G. H. JONES . . . . Principal Hydraulic Engineer, Sacramento River Flood Control Project
T. B. WADDELL
Principal Hydraulic Engineer, Central Valley Project
GORDON ZANDER
Principal Hydraulic Engineer, Water Rights
HARVEY O. BANKS . Supervising Hydraulic Engineer, Water Pollution Control Investigations
WILLIAM BERRY
Supervising Hydraulic Engineer, California Water Plan
MAX BOOKMAN
Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER . . . . Principal Attorney
T. R. MERRYWEATHER . . . Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD . . . . State Architect
H. S. HUNTER . . . . Deputy Chief
ROBERT W. FORMHALS
Administrative Assistant to State Architect
EARL W. HAMPTON . Supervisor of Contract Architects

Administrative Service

W. K. DANIELS . Assistant State Architect, Administrative
WADE O. HALSTEAD
Principal Estimator of Building Construction
CARLETON PIERSON . . Supervising Contracts Writer

Planning and Design Service

P. T. POAGE
Assistant State Architect, Design and Planning
A. F. DUDMAN . . . Principal Architectural Designer
CARL A. HENDERLONG
Principal Mechanical and Electrical Engineer
C. L. IVERSON
General Supervising Architectural Draftsman
ELLIOTT ADAMS . . . Architectural Property Analyst
WALTER E. LORD . Supervising Specifications Writer
JAMES A. GILLEM . Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT . . . . Chief Construction Engineer
F. A. JOHNSON . . . . Principal Structural Engineer
JOHN S. MOORE . . . General Construction Superisor
NATE W. DOWNES
Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN . . . . Area I, Oakland
W. H. EPPERSON . . . . Area II, Sacramento
FRANK R. AUSTGEN . . . . Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD . . . . Area I, San Francisco
M. A. EWING . . . . Area II, Sacramento
H. W. BOLIN . . . . Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 49731 9-51 29 5J

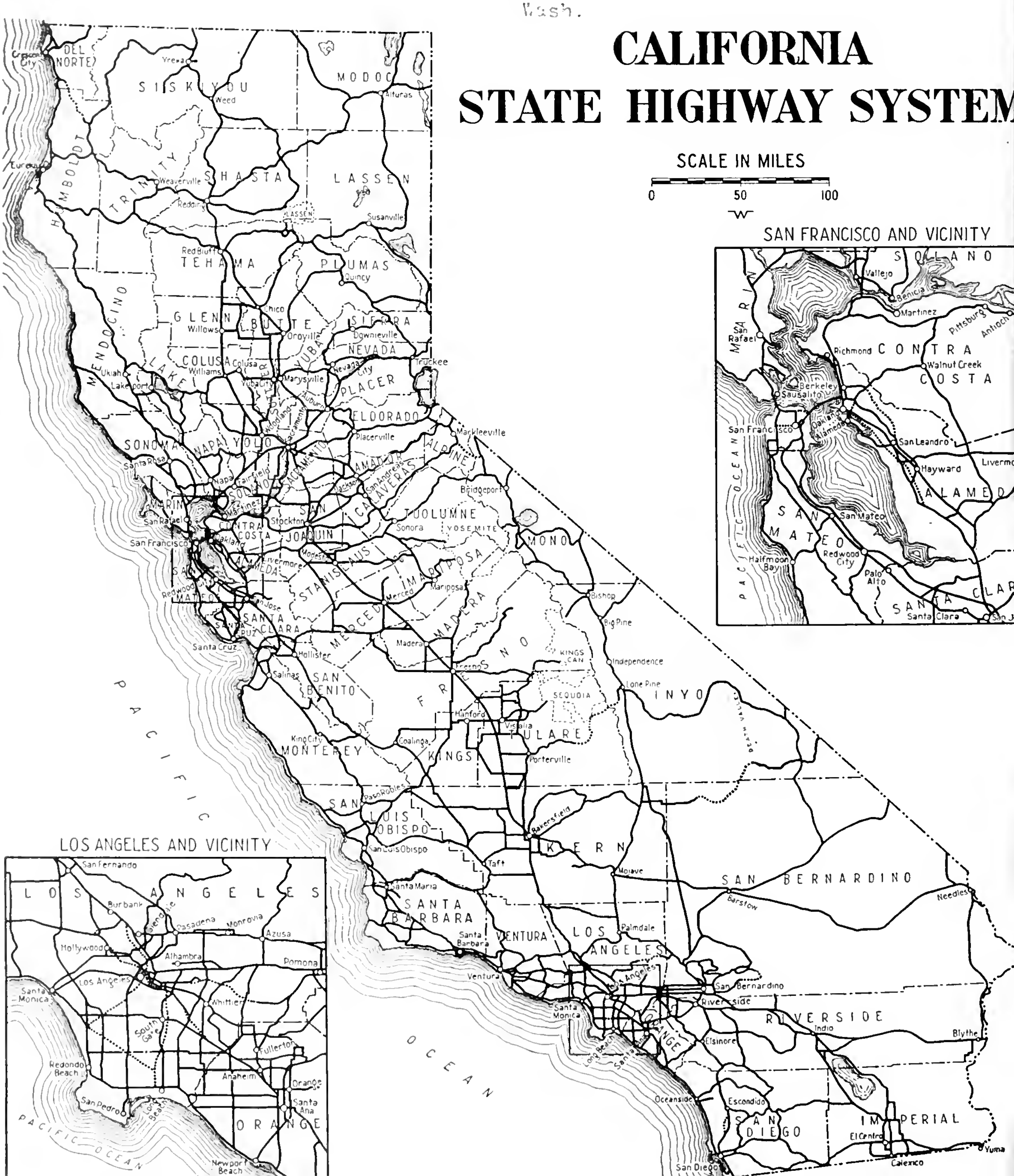
California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

Seattle Public Library,
Seattle,
Wash.

SEC. 34.66 P. L. & R.
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

CALIFORNIA STATE HIGHWAY SYSTEM



CALIFORNIA
HIGHWAYS AND PUBLIC WORKS

California Highways and Public Works

Official Journal of the Division of Highways, Department of Public Works, State of California

FRANK B. DURKEE, *Director*
GEORGE T. McCOY, *State Highway Engineer*
KENNETH C. ADAMS, *Editor*
HELEN HALSTED, *Associate Editor*
MERRITT R. NICKERSON, *Chief Photographer*

Published in the interest of highway development in California. Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request.

Address Communications to
CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. BOX 1499
Sacramento, California

Vol. 30 November-December Nos. 11, 12

Public Works Building Twelfth and N Streets Sacramento

CONTENTS

Civil Defense

Part Public Works Department Will Play If Emergency Arises

By RODNEY C. RICHARDSON, Assistant to Public Works Director

EMPLOYEES of the Department of Public Works are "Shock Troops" of civil defense and disaster relief in California.

The State Civil Defense and Disaster Relief Plan, developed under the direction of W. M. Robertson, Major General, U. S. A. (Ret.), is advisory in character to political subdivisions below the state level, in recognition of their autonomy. It is realized, however, that an attack by enemy forces would undoubtedly cause a condition that would require augmentation of local relief forces, and trained engineers will be one of the most important single categories of manpower needed for effective assistance. For that reason, as well as certain other obvious conclusions, the Department of Public Works has been assigned the responsibility for providing the staff for the Engineering Service Division of the Office of Civil Defense.

The Chief of Engineering Service in the Office of Civil Defense is Dwight F. Johns, Brigadier General, U. S. A. (Ret.), formerly of the Corps of Engineers, and who is familiar with our department, through his World War II assignment at San Francisco. In case of a "stare of extreme emergency" his headquarters staff will be composed of top-flight engineers from each of the three operating divisions – namely, Architecture, Highways, and Water Resources.

The Office of Civil Defense has set up 10 regions, each of which is headed by a regional coordinator, and, with the exception of the area surrounding Sacramento, these regions roughly correspond to the highway districts in the State. In the case of Sacramento, that particular civil defense region includes Highway Districts III and X.

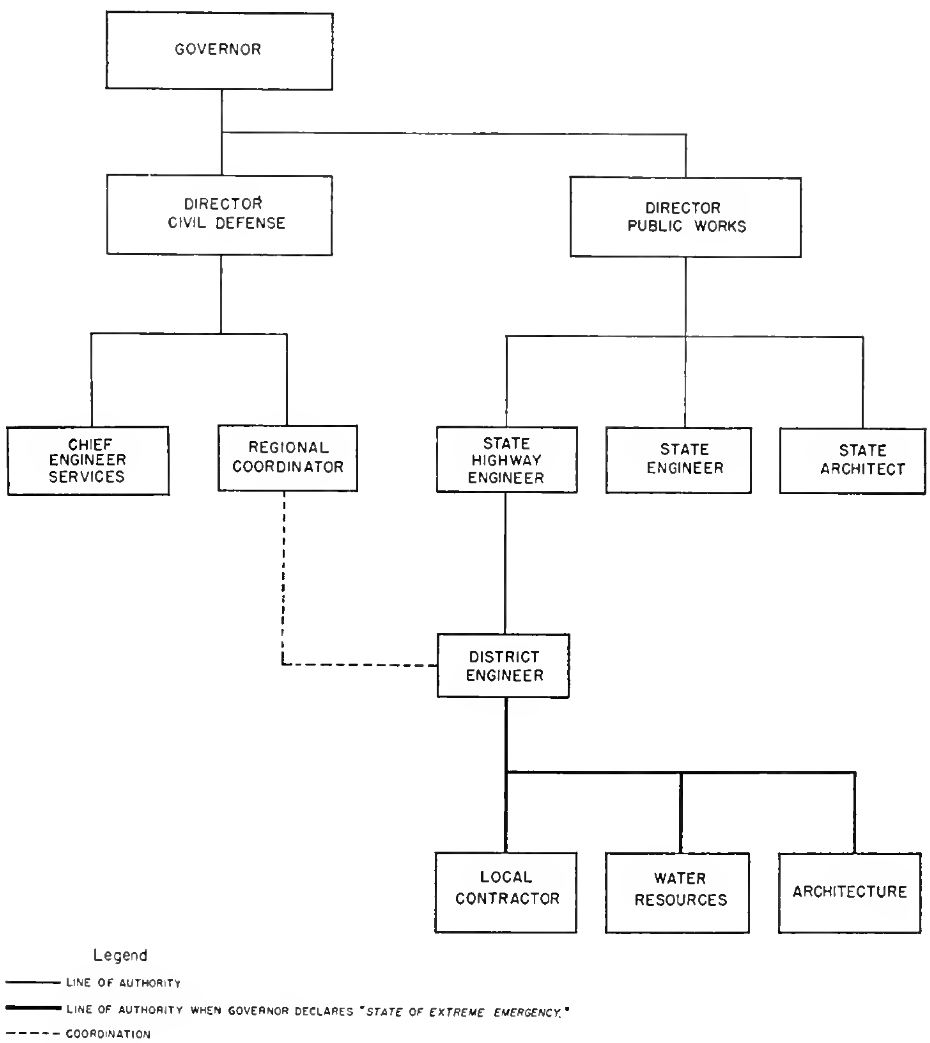
For the actual operations of Engineering Service, the District Engineer of the Division of Highways, as listed below, will be the chief for the respective civil defense region:

CALIFORNIA STATE CIVIL DEFENSE AND DISASTER RELIEF PLAN

ANNEX 4d.

ENGINEER SERVICES

INCLOSURE-I



Region 1—District Engineer, District	I
Region 2—District Engineer, District	II
Region 3—District Engineer, District	IV
Region 4—District Engineer, District	X
Region 5—District Engineer, District	V
Region 6—District Engineer, District	VI
Region 7—District Engineer, District	V
Region 8—District Engineer, District	VIII
Region 9—District Engineer, District	VII
Region 10—District Engineer, District	XI

The State Highway Engineer will control engineering service operations within a region during a "state of extreme emergency," through direction of the appropriate district highway engineer whose forces will be reinforced by the available personnel from the Divisions of Architecture and Water Resources, in cooperation with the regional coordinator.

. . . Continued on page 35

Powdered Rubber

Its Experimental Field Use in Bituminous Plant-mix Surfacing

By ERNEST ZUBE, Senior Materials and Research Engineer

During the past few years the use of rubber in one form or another as an admixture to bituminous surfacing has been advocated by the rubber industries. Adding rubber either in reclaimed powdered form or crude natural rubber to asphalt pavement is not a recent development. Just prior to the second world war, experimental test sections containing rubber were placed in the East Indies and some European countries, and reportedly are still in good condition.

The advantages claimed for rubber-bituminous mixtures are:

1. Improved stability due to lower temperature susceptibility.
2. Better sealing quality, thereby preventing water from seeping through the surface mixture.
3. Reduction in maintenance expense, and
4. Better nonskid properties.

During 1949 and 1950, experimental rubber-bituminous mixtures were placed in various states, such as Virginia, Ohio, Texas, Massachusetts, Minnesota, California and others.

This article covers the installation of the California experimental section which consists of plant-mixed surfacing to which was added reclaimed powdered rubber. The section is located in Highway District III on Road III-Pla-37-A, U. S. Route 40 and is part of the new four-lane highway between Auburn and Applegate constructed during 1950 under Contract 51-3TC4.

Auburn-Applegate Project

The test section is confined to the outer eastbound lane only and extends from Station 200+50 to Station 230+11, or a distance of 2,961 feet. Approximately one-half of this distance is on a 1.8 percent grade and the other one-half on a 5.9 percent grade. The outer lane, especially on the steeper grade, will be subjected to rather heavy truck traffic and it was felt that the advantages from the addition of the rubber, if any, should be more

EXPERIMENTAL RUBBER PAVEMENT

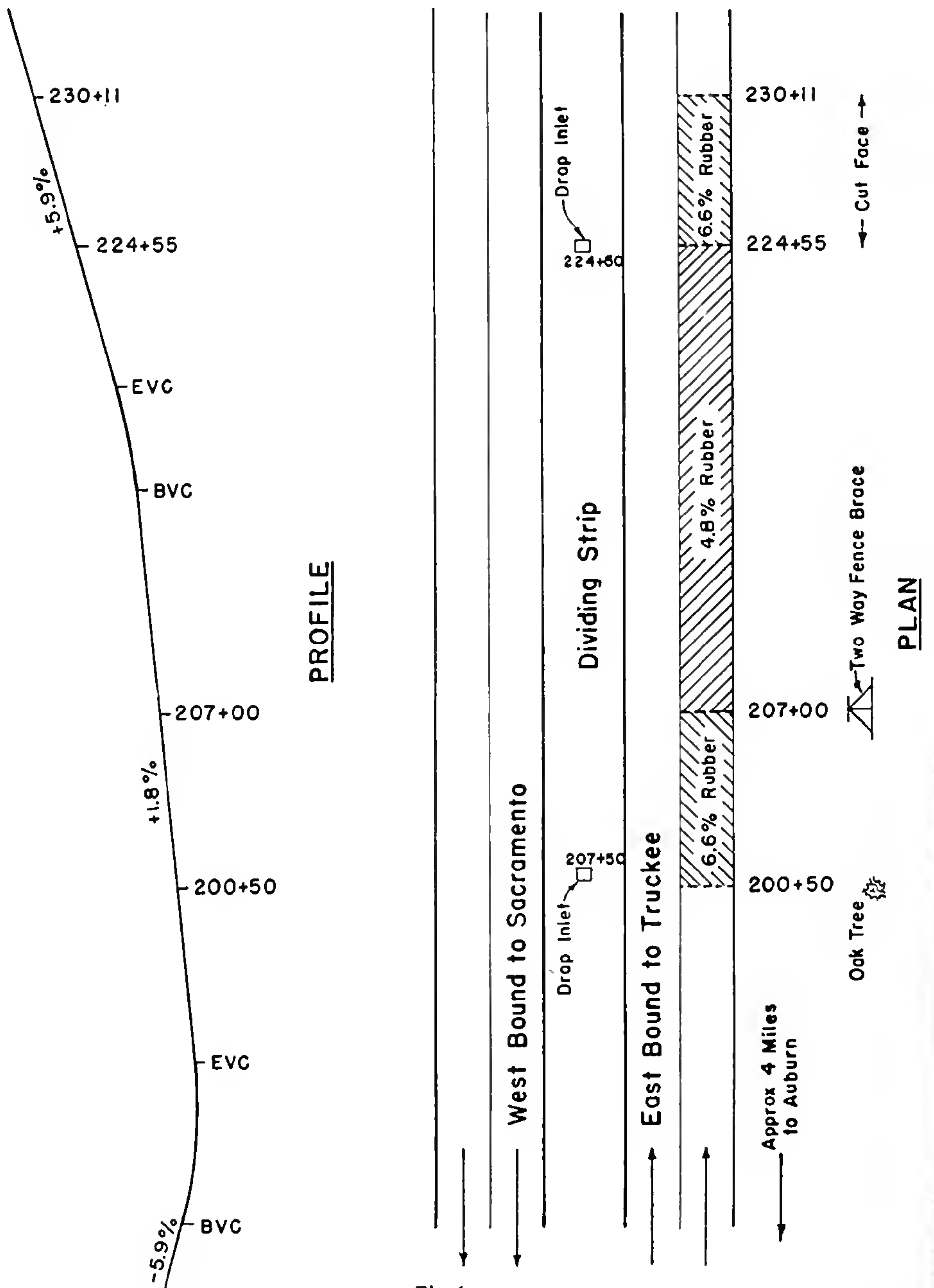


Fig I

easily discernible in the heavily traveled lane. Small identification markers are placed along the right of way to indicate the limits of the experimental section (*See Photo 10*).

It was planned to add approximately 5 percent and 7 percent of rubber by weight of the asphalt to the plant-mix. Therefore, the length of the section was divided into three portions, the

two ends to contain about 7 percent of rubber and the middle portion 5 percent. This arrangement permitted the placing of both mixtures on the flat grade as well as on the steep grade. The accompanying drawing, *Fig. 1*, illustrates the layout.

Construction

The plant-mix surfacing conformed to Section 28 of the Standard Specifications, three-fourth-inch maximum size aggregate, with 150-200 penetration paving asphalt as the bituminous binder. The aggregate consisted of Bear River crushed gravel and the asphalt was obtained from the Five C Refining Company. The regular plant-mix surfacing contained an asphalt content of 4.1 percent but an additional 0.1 percent of asphalt was added for the asphalt-rubber mixture to take care of the absorptiveness of the powdered rubber. The structural section consisted of a two-inch thick surface course placed with a Barber Greene finishing machine on a two-inch blade spread leveling course. The rubber was added to the surface course only. The base was cement treated with 3 percent of Portland cement.

The powdered reclaimed rubber in the amount of one ton was furnished to the State free of charge by one of the leading rubber companies and was delivered to the job in sacks weighing about 115 pounds each.

A grading analysis of the rubber was as follows:

No. 4 sieve	100% passing
No. 8 sieve	99% passing
No. 16 sieve	99% passing
No. 30 sieve	69% passing
No. 50 sieve	17% passing
No. 100 sieve	2% passing
No. 200 sieve	1% passing
No. 270 sieve	1% passing

Mixture Used

A batch consisted of 4,000 pounds dry aggregate and 168 pounds of asphalt. As the rubber was to be only 5 percent to 7 percent by weight of the asphalt, the amount added per batch was 8.40 pounds and 11.76 pounds, respectively. Due to the vibrations of the plant, it was not practical to weigh out such small quantities. Therefore, a calibrated container was used and the proper amount of rubber was added by volume measurement.

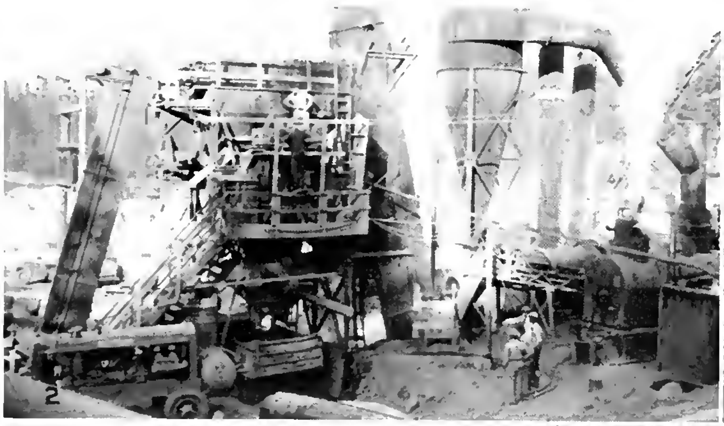
The rubber was added to the dry mix by means of an improvised chute from a platform constructed above the plant operator. The charge was then mixed dry in the pugmill for a period of approximately 20 seconds to thoroughly distribute the small amount of rubber. The asphalt was then added and mixing continued for a period of 35 seconds.

The total tonnage of asphalt-rubber mixture was 436.95 tons. Based on 2,000 pounds of powdered rubber furnished, a recalculation showed that actually only about 6.6 percent of rubber was used for the intended 7 percent portion and 4.8 percent for the intended 5 percent portion.

Conventional Spread

The mix was hauled in trucks from the plant site to the job and spread

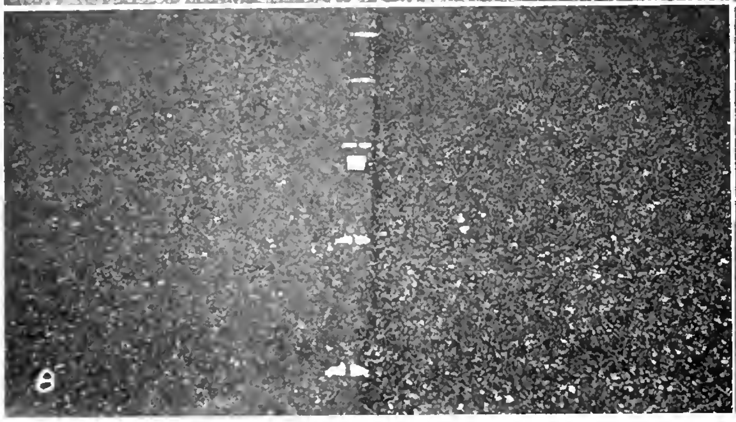
PHOTO 2—General view of plant (rubber added at top platform). PHOTO 3—Experimental section on right after rolling (leveling course at left). PHOTO 4—Placing surface with Barber-Greene. PHOTO 5—Close-up of bituminous surface with rubber added. (Pictures taken August 21, 1950.)


2


3


4


5



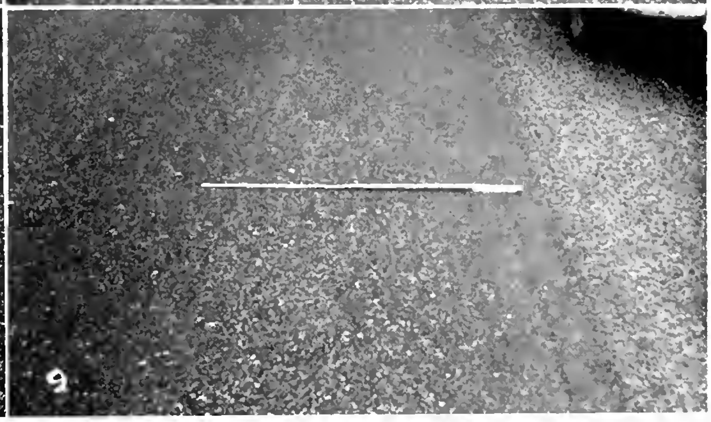


PHOTO 6—Close-up of surface, 6.6% rubber added. PHOTO 7—Close-up of surface, 4.8% rubber added. PHOTO 8—Plant-mix with rubber, right; plant-mix without rubber, left. PHOTO 9—Plant-mix with rubber, foreground; plant-mix without rubber, background. (Pictures taken February 14, 1951.)

with a Barber Greene finishing machine in the conventional manner. The materials were mixed at a plant temperature of about 300 degrees F. and spread on the road at an average temperature of 250 degrees F. No noticeable differences between the mix containing rubber and the portion containing no rubber were observed during spreading or compaction operations. Tests made in the laboratory on four samples of the rubber mixture,

TABLE 1—EXPERIMENTAL RUBBER SECTION

Test No.	SIC No.	Dist. No.	Location	Percent Rubber added	Test results							Remarks
					Percent Bit. by Extr.	Per-cent 200	Stab. 140°	Cohes.	Swell	MVS stab.	MVS moist	
1667	A-4160	778	Ld. #6. 229+50 Outs. E. B. Lane	6.6	4.0	4	40	175	.002			Placing Temp. 250°F.
1668	A-4162	780	Ld. #25. 221+ Outs. E. B. Lane	4.8	4.2	5	42	263	.000			Placing Temp. 240°F.
1669	A-4161	779	Ld. #46. 221+06 Outs. E. B. Lane	4.8	4.1	4	42	290	.001	27	0.4	Placing Temp. 260°F.
1670	A-4163	781	Ld. #70. 202+18 Outs. E. B. Lane	6.6	4.1	4	38	225	.000	30	0.4	Placing Temp. 260°F.
1671	A-4164	782	Ld. #98. 198+80 Outs. E. B. Lane	0.0	4.1	3	38	116	.003	27	0.3	Placing Temp. 245°F.
Above surface mixes placed on August 21, 1950.												
Average of rubber mixtures					4.1	4.25	40.5	238		28.5	0.4	
Average of regular surface mixtures entire job					3.7	3.7	39	183		27	0.3	

when compared with those of the regular routine field samples from this job, showed no noticeable differences in test results except there appears to be some tendency towards higher cohesion results with the rubber mixture.

A table showing test results of samples representing the rubber mixture is attached.

Cost Comparison

The cost of placing the experimental section, exclusive of the rubber, was \$2,365 or

$$\frac{\$2{,}365}{437 \text{ tons}} = \$5.42 \text{ per ton of asphalt-rubber mix}$$

The cost of an equivalent section of regular plant-mix surfacing based on bid prices would have been—

Aggregate	419 tons at \$2.62 =	\$1,098
Asphalt	18 tons at 20.00 =	360
		\$1,458

or—

$$\frac{\$1{,}458}{437 \text{ tons}} = \$3.34 \text{ per ton of regular mix.}$$

Net cost of experiment—

$$\begin{array}{r} \$2{,}365 \\ -1{,}458 \\ \hline \$907 \end{array}$$

or—

$$\frac{\$907}{437 \text{ tons}} = \$2.09$$ extra cost per ton of asphalt-rubber mix. (Rubber furnished free) or 62 percent increase over regular mix.

Unfavorable Comparison

The above cost comparison is obviously unfavorable to the rubber mixture. In this cost is included the erection of a platform for adding the rubber, additional dry mixing time, standby time for trucks, etc. The increase in price per ton for the rubber mixture cannot be considered a criterion had the surface mixture for the entire job been set up as a rubber-asphalt mixture. If this had been the case, the powdered rubber would have been added to the asphalt at the refinery and the additional cost would have been the cost of the rubber plus the time required to mix the rubber with the asphalt.

Although the powdered rubber for this experimental section was furnished

PHOTO 10—Small markers at shoulders identify experimental section. PHOTO 11—General view of experimental section looking east. PHOTO 12—Plant-mix with rubber, right; plant-mix without rubber, left. (Pictures taken February 14, 1951.)

free of charge, the cost per pound in the summer of 1950 was approximately 15 cents for reclaimed rubber and 45 to 50 cents for natural rubber. Assum-

ing an average plant-mix surfacing requiring about 4.5 percent of asphalt and adding 5 percent rubber (by weight of the asphalt), the estimated cost of the rubber per ton of plant-mix would be:

Regular plant-mix—per mile approx.	$7,370
Plant-mix—5 percent reclaimed rubber added—per mile approx.	$8,402 (estimated)
Plant-mix 5 percent natural rubber added—per mile approx.	$10,392 (estimated)

It is too early to predict whether the beneficial effects derived from this treatment will be sufficient to warrant the increased cost of the surfacing. However, based on reported experience elsewhere, it seems doubtful that the extra cost of adding rubber can be justified.

Reclaimed Rubber

As previously mentioned, the rubber used in the test section consisted of powdered reclaimed rubber such as may be obtained from ground up automobile tires or similar rubber crumbs. The type of rubber currently advocated by the Rubber Bureau is natural plantation rubber. It is therefore evident that the ultimate service record of the test section cannot be taken to indicate virtues of the natural rubber.

The experimental section was placed August 21, 1950. The pavement was subjected to some intermittent traffic during construction and was opened to traffic in October, 1950. Profilograph records of the experimental rubber-treated section and also of the adjacent pavement which had no rubber added to the mix were obtained on November 29, 1950. There was no discernible difference in roughness or riding qualities between these sections.

Skid Resistance

Skid resistance measurements of the rubber-treated section and adjacent untreated sections were made in April and August, 1951, by Professor R. A. Moyer of the Traffic Institute of the University of California. On the dry pavement there was no measurable difference in the coefficient of friction on any of the sections. On the wet pavement the rubber-treated section showed slightly higher coefficients of friction. (*See Figure 13*). This confirms results obtained on similar sections in other states.

. . . Continued on page 58

Detroit Experiments With Rubber Paving

COOPERATING with the Asphalt Division of the Detroit Public Works Department, the Firestone Tire and Rubber Company installed three test sections of Rub-R-Road on Bagley Avenue from First to Fourth Streets in the City of Detroit, Michigan.

Delegates and engineers attending the fifty-seventh annual Public Works Congress in Detroit at the time were among the most interested spectators.

Each of the three test sections consisted of 60 tons of rubberized paving mixture, with one section utilizing GR-S rubber, another section, natural rubber, and the third section, processed rubber.

In the above photograph, Detroit public works officials and Firestone representatives observe the installation of the rubber road. They are, left to right: Jan Schmedding, Superintendent, Street Construction, Detroit; H. V. Carlson, Rubber Roads Engineer, Firestone; Charles L. Shattuck, Manager, Detroit Public Works Department, and J. R. Moore, Firestone Engineering Department.

Traffic Engineering in the State of California

By J. C. YOUNG, Traffic Engineer, California Division of Highways

HISTORY

TRAFFIC ENGINEERING, as such, was first formally recognized in the California Division of Highways with the appointment of a safety engineer and organization of a Safety Department in March of 1938. Certain work now done by traffic engineers, such as traffic counting, signing, striping, and some accident analysis had previously been performed by the Maintenance Department, somewhat as a sideline to their regular maintenance work. The chief purpose of the organization of the Safety Department was study of the accident problem on the State Highway System, and coordination of all activities within the division to improve traffic conditions and promote safety.

In July of 1939, the fledgling Safety Department officially took over control of all accident and traffic data, including all traffic counts, traffic control devices—such as signs, signals and traffic stripes—employee safety work, and review of traffic and safety features in design. At that time the Headquarters Safety Department consisted of six engineers and five clerical employees, with an ultimate organization chart calling for two additional engineers and six more on the clerical staff.

Beginning of Department

The district offices, of which there are 11 throughout the State, at that time had no separate traffic sections, and the organization plans included full time personnel on traffic work in only the two metropolitan districts; namely, San Francisco and Los Angeles. Possible assignment of one man full-time on traffic work was suggested for two of the next larger districts, with traffic engineering to be handled as a part-time job for one man in each of the other seven districts. In other words, in 1939 it appeared that the state-wide traffic organization would not exceed 30 persons.

Increase in Traffic Volumes

A number of subsequent events, most important of which was of course the tremendous increase in traffic volumes, made it necessary to gradually expand the Traffic Engineering Section. The State Legislature in 1941 enacted legislation which gave the Division of Highways rather broad authority with regard to speed zoning on state highways. Again in 1947 additional legislation greatly expanded this authority with regard to speed zoning. In 1942 the title of the Safety Engineer was changed to Traffic and Safety Engineer, and in 1944 the "Safety Department" was renamed the Traffic Department. In that same year the preparation of the highway construction budget was placed under the jurisdiction of the Traffic and Safety Engineer, and the Highway Planning Survey was also made a part of the traffic department.

In 1947 legislation was passed which provided funds for a considerably augmented highway construction program, and in order to carry on this program a major reorganization of the entire Division of Highways was necessary. The organization, as developed in 1947, has remained essentially the same up to the present time, and is as described below under "Present Organization."

Present Organization

The Division of Highways, as presently organized, consists of seven major sections under the State Highway Engineer. Each major section is under the direct supervision of an Assistant State Highway Engineer, or equivalent. The major subdivisions are: Public Relations and Personnel, Operations, Administration, Planning, Bridges, Right of Way, and Accounting. Within each of these major subdivisions there are several separate departments. The Traffic Department is in the Planning Section, along with Advance Planning, Design, Budgets, and Highway Planning Survey. The various department heads within the several major subsections carry equal responsibility and authority. For instance, Traffic, Design, Maintenance, Construction and several others are separate departments at the same level of authority.

Actual functions within the Traffic Department itself are best shown on the accompanying organization chart for Headquarters Traffic Department. As previously mentioned, there are 11 districts in the State, each headed by a district engineer, and at the present time there is a traffic engineer and a traffic organization in each district. District traffic organizations vary from one or two men in the small outlying rural districts to 35 men in the metropolitan districts. Total district traffic personnel throughout the State now numbers approximately 125 with a Headquarters personnel of 30, for a total of 155 persons now engaged in traffic work.

Annual Budget

The budget for traffic engineering amounts to approximately $400,000 a year, and in addition engineering work totaling about $500,000 a year is performed by "Traffic Department" personnel for other departments and hence charged against other budget accounts. The annual construction budget for traffic improvements initiated and designed by the Traffic Department, chiefly channelization, signalization and illumination of intersections, amounts to approximately $1,800,000. The annual cost of signing, including new signs and maintenance and replacement of existing signs, is approximately $375,000.

Although the organization chart reproduced herewith is for Headquarters Traffic Department, most of the functions shown thereon are also performed at district level. The major exceptions are Traffic Research and Geometric

Standards. Most traffic research studies are supervised by Headquarters personnel, in many cases with the cooperation of district forces. Development of geometric standards for use in design on a state-wide basis is necessarily a Headquarters function, and little of this type of work is done in the districts.

Generally speaking, Headquarters acts as a review and advisory body, while actual initiation of traffic improvement projects and their design is done at the district level. For instance, placing of signs is actually performed by the District Maintenance Department, but the requisition for the sign is initiated by the District Traffic Engineer, and reviewed and approved by Headquarters Traffic Department. In the discussion of Traffic Department activities which follows, it should be borne in mind that where mention is made of review by Headquarters Office, the subject matter which is reviewed has been prepared by the District Traffic Department.

Present Activities

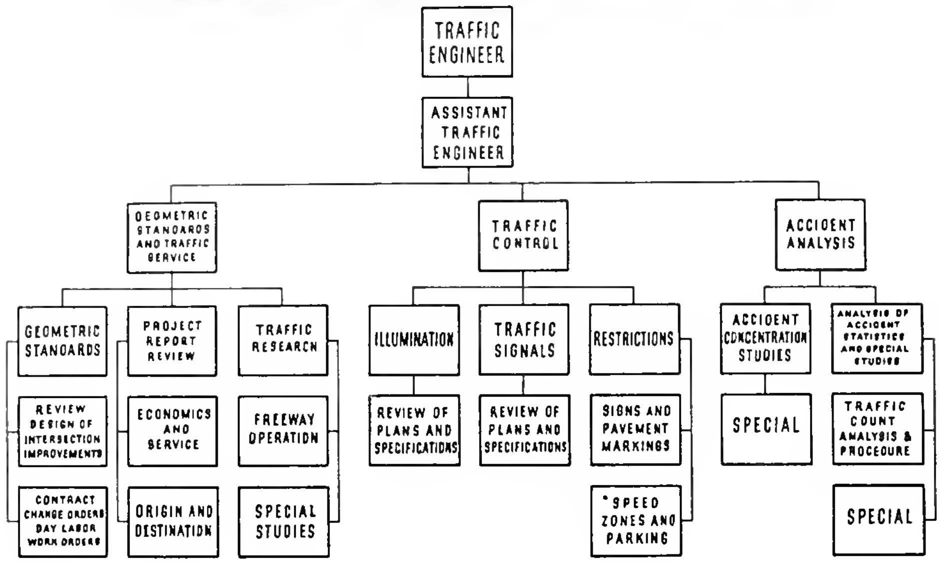
Many of the duties of any traffic department fall under the heading of routine chores, although special problems may be involved in many cases. Some of the items in California which might be classed as routine, in that they are continuing functions, are signing, striping, establishment of speed zones, annual and monthly traffic counts, parking restrictions, project reports, study of points of recurring accidents and intersection design, either with or without signals and illumination.

Maintenance of all highway facilities, including traffic control devices, is performed by the Maintenance Department.

Speed Zoning

Speed zoning in California requires a traffic engineering study at each proposed zone. Twenty-five mile limit business and residence zones are automatically authorized when roadside development reaches a certain density. However, the law authorizes the Division of Highways to raise these 25-mile zones to 35 or 45 miles per hour if an engineering investigation indicates such higher speeds to be suitable. The law also empowers the division to lower the prima facie 55-mile per hour

ORGANIZATION CHART
HEADQUARTERS TRAFFIC DEPARTMENT



limitation to 45 or 35 miles per hour upon engineering investigation where density of roadside development does not call for a business or residence zone.

The engineering investigation as made in California consists of the following: A rough topographic survey is made and a speed zone map is prepared which shows alignment, grades and roadside development. An accident profile is also prepared, which shows the past record of the proposed zone. In addition, spot speed checks are taken at various locations in the area. On the basis of this data the appropriate speed is selected for posting. As a policy, the speed selected is not less than the lower limit of the pace and not higher than the critical or 85 percentile speed.

Project Reports

In California, a project report is prepared in the district office covering each individual project which is proposed for construction. Since these project reports are used to establish the necessity for and adequacy of the project, and also its priority, the traffic information in the report is of course of major importance. The traffic portion of each project report is prepared by the District Traffic Department and reviewed at Headquarters. Where alternate locations are available, the traffic service which will be rendered by each alternate must be analyzed, and in order to determine this traffic service it is often necessary to make an origin and destination survey.

California has made a large number of such surveys, ranging from the home interview type covering large metropolitan areas and requiring a year or more to complete to simple roadside interview surveys which may be completed in one or two days. The technique usually employed involves stopping and interviewing motorists at strategic points on the existing road system. Information so obtained is coded and tabulated on punch card equipment. Methods have been developed which reduce the manual work of analysis to a minimum and such surveys are becoming more and more popular. Frequently several will be under way at various locations in the State at the same time.

Accident Studies

A continuous before-and-after study at points of recurring accidents is being carried on in the Headquarters Traffic Department. A card index is kept of all points on the highway system where the accident rate appears to be abnormally high. The cards which are made up for these points of recurring accidents are reproduced

herewith. Card "A" represents the collision diagram "Before" and is used for study to determine suitable corrective measures. After a corrective measure has been installed, any accidents which occur are plotted on card "B." Card "C" is a chronological listing of the accidents and any improvements which are made at the specific point.

This sysrem provides a continuous before-and-after study at several hundred points on the State Highway System, and with very little work it is possible to determine the effect of the various types of safety devices which have been installed since this card system was put into effect. Although the card index system described is being kept only in Headquarters Office, each district likewise keeps accident profiles and other traffic data on all highways within rhe district.

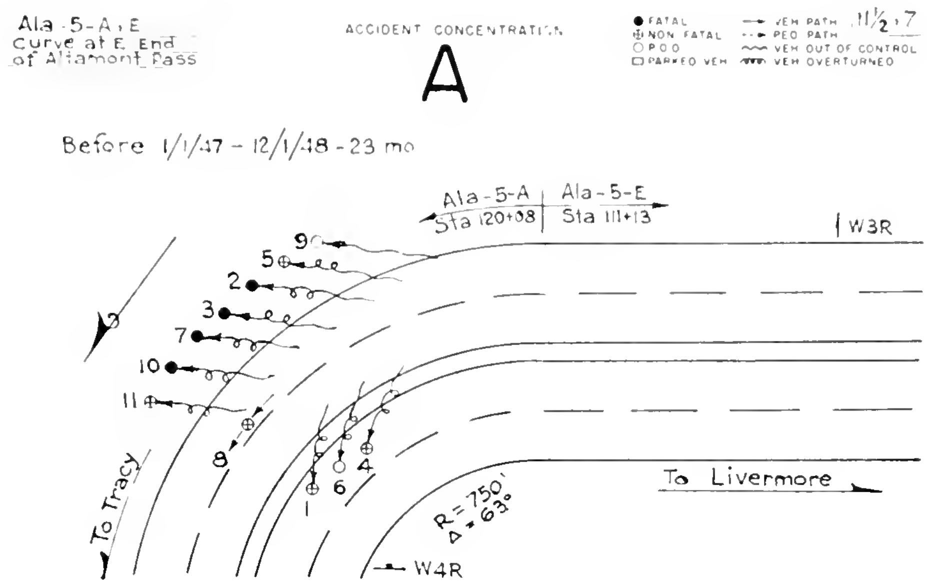
Intersection Design

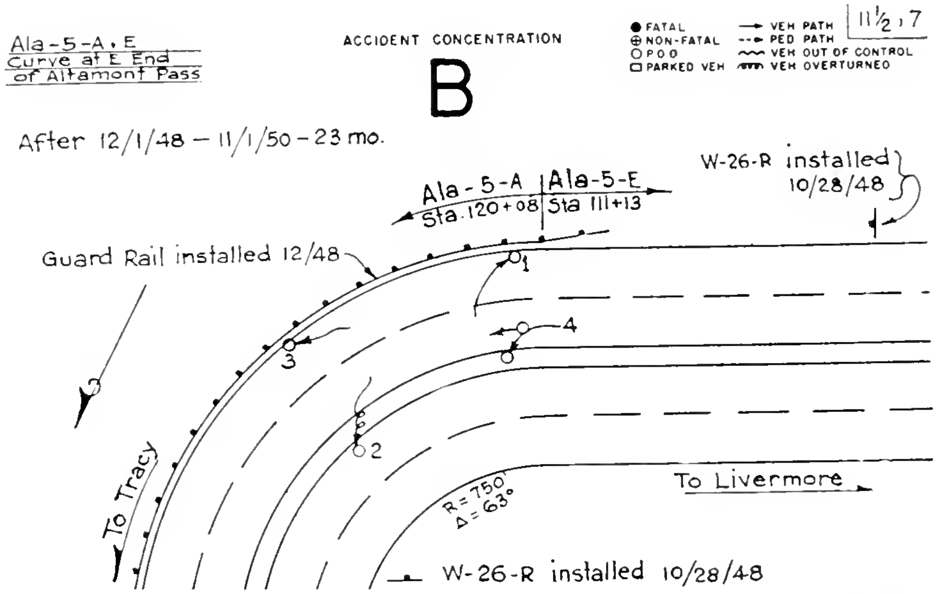
Intersection redesign, and in some cases original intersection design on new projects, is a function of the Traffic Department. Such designs may include either channelizarion, signals or illumination, or any combination thereof. All types of signals are in use on the California State Highway System; however, many of the installations are of the fully actuated type. It is worthy of note that the three-phase signal, once considered to be a congestion producer, is now becoming very popular with the motoring public and many of the recent installations of three-phase traffic actuated signals are proving highly satisfactory.

Lighting Installations

The Traffic Department initiates and designs lighting installations on state highways. The policy of the division is to provide illumination only at points of conflict or hazard. In other words, California ordinarily does not provide continuous illumination of highways. This practically limits highway lighting to intersections and interchanges, and the lighting section of the Traffic Department has made many studies of types and location of luminaires to determine the combination which gives the best results at such points of traffic conflict.

California has actually developed a new fluorescent type luminaire specifi-





IV-Ala-5-A.E
Curve at E. End of Altamount Pass

C

11½, 7

L DAYLIGHT; D DARK; DA DARK W/LIGHTS; NS NOT STATED; N NEVER
R RARELY; F FREQUENTLY; PED PEDESTRIAN; C CAR; B BUS
P PANEL OR PICKUP; T TRUCK; TT TRUCK & TRAILER; M MOTORCYCLE

ACC NO	DATE	TIME	LITE	SEVERITY F	NF	PDO	USE 1	2	DESCRIPTION
1	1 31 47	19 20	D		1		R	-	C'EB pulling Trailer exceeding safe speed, went out of control on curve and overturned.
2	7 4 47	01 30	D	1	1		NS	-	C'EB, HBD, high speed, evidently came upon another veh. swerved to right, over embankment.
3	10 21 47	05 30	D	2			NS	-	C'EB, at high speed over drove curve, down embankment
4	1 28 48	16 00	L		1		NS	-	C'EB forced into center division by another veh. over div. then over bank, excessive speed.
5	3 30 48	00 05	D		1		F	-	TTEB at high speed over drove, possible caused by blowout.
6	4 21 48	15 00	L			✓	R	-	C'EB, wet, out of control, over center division on to shoulder.
7	5 13 48	20 00	D	2			NS	-	C'EB, high speed, over drove curve, over embankment
8	7 14 48	18 30	L		1		F	R	C'EB, high speed, HBD hit C²EB in rear.
9	7 31 48	01 30	D			✓	F	R	C'EB, high speed, over drove curve, over embankment.
10	9 26 48	01 15	D	1	1		NS	-	C'EB, Drunk, high speed, over drove curve.
11	10 2 48	23 00	D		3		NS	-	C'EB, high speed, over drove curve.
									2-W26R's Installed 10/28/48, Guard Rail 12/48
1	9 19 49	NS	D			✓	NS	-	C'WB at high speed crowded over division, hit guard rail
2	3 4 50	00 35	D			✓	N	-	C'EB, high speed, hit island and overturned
3	N.S	N.S.				N.S	N.S.		Evidently C'EB, hit guard rail (no details)
4	9 26 50	13 16	L			✓	F	F	TT'EB, changing lanes, hit in rear by C²EB who then hit div.

cally designed for intersection lighting. This unit showed up very well on the first installation, and additional units are planned for further trial installations at an early date. In the electrical field, California has also pioneered in the illumination of directional signs with fluorescent tubes. Fixtures for mounting the lights at the bottom of the sign are being developed and considerable benefits are expected. Placing the lighting fixture at the bottom eliminates objectionable glare at night and also eliminates shadows on the sign during the day.

Special Studies

Aside from the routine functions of the Traffic Department, many special studies are made by the Traffic Research Group. The line between traffic research and establishment of geometric standards cannot be clearly drawn, since most research is aimed at ultimate improvement of design standards. At the present time the Traffic Research Group has several studies under way. One is an over-all study of intersections on four-lane divided expressways.

. . . Continued on page 58

Overhead signs on Santa Ana Freeway. Night and day photos.

Overhead sign bridge on North Sacramento Freeway

UPPER—Mission Valley interchange, looking east. Photo taken just before official opening. LOWER—Mission Valley interchange photo taken at 2.30 a.m.

Budget Review

Director of Public Works Tells How Highway Funds Are Allocated

The following address on the subject "The 1952-53 State Highway Budget" was delivered by Director of Public Works Frank B. Durkee, who is also chairman of the California Highway Commission, before the Highway Section of the California State Chamber of Commerce at the Biltmore Hotel in Los Angeles on Thursday, November 29, 1951, on the occasion of the 24th annual meeting of the State Chamber.

The State Highway Budget, like all budgets, is a reflection of the people's desires and needs, within certain economic limits. In California, the people for whom we budget daily gain in numbers. In 1940, the State Government was concerned with a population of less than 7 million; more important to the California Highway Commission was the motor vehicle registration, at that time approximately 3 million. In 1950, the population had increased to more than 10½ million, and the motor vehicle registration to more than 5 million.

The research department of your own organization has estimated that by 1960 California will have a population of more than 14 million, with 6½ million vehicles using our streets and highways.

We do not deplore this phenomenal growth. We do not say to these newcomers things would be more pleasant in California, if you had gone elsewhere. And no one has suggested relieving congestion on our streets and highways by selling fewer automobiles. Happily, we acknowledge our destiny lies in our continued growth. One need only consider the way we have met the challenge of the problem of water supply, to realize that the attitude of Californians toward the problems that come with growth is a positive attitude.

The California Highway Commission shares this positive attitude, as its policies and decisions have consistently demonstrated. But, in adopting the annual budget, the commission is necessarily governed, like other agencies of government, by the means at hand.

For the next fiscal year, July 1, 1952, to June 30, 1953, the gross State Highway Budget amounts to $186,500,000. This total includes two items not applicable to state highways, as such:

$21,803,000 is allocated to cities for city streets, representing the ⅝ of a cent per gallon of gasoline tax provided by law for this purpose; and

$5,282,000 is federal-aid secondary funds, 87½ percent of which, under legislative direction, is available for construction on county roads.

The total amount, therefore, which may be regarded as available for state highways is approximately $159,400,000.

Of this total, a sum of $23,000,000 is required for maintenance of the 14,000 miles of highway in the state system; and approximately $10,000,000 is set aside for capital outlay for buildings, plants and equipment; continuation of long-range planning studies; and general administration.

The Construction Budget

This leaves a total or gross construction budget of $126,300,000. The total cost of budgeted right of way and major construction projects, without engineering and contingencies, is $103,430,000. The amount set aside for purchase of rights of way accounts for nearly one-fourth of the $126,300,000, or $31,337,000. After deducting the cost of preliminary engineering, there remains the sum of $87,000,000 for construction purposes, including contingencies and construction engineering.

In accordance with the distribution provided for by law between the north and the south, the allocations to construction projects, including rights of way, are apportioned; to the 45 northern counties, 45 percent, or $58,845,000; to the 13 southern counties, 55 percent, or $67,491,000.

It is significant, I think, that out of this total of $126,300,000 in the construction budget (which, as indicated, includes rights of way) more than $45,000,000 is allocated for the continuation of the California major freeway program.

There is, of necessity, some element of the crystal ball in all budget-making. This is particularly true in an activity so sensitive to inflationary pressures as the construction field. The State Highway Budget, as to the number of projects included, is based largely on what our engineers anticipate construction costs will be during the coming fiscal year. We know, to some extent at least, what factors will influence the highway price structure, but it is impossible to foretell, for example, just how high these factors may send the California Highway Construction Cost Index.

Based on a 1940 level of 100, the index reached its first postwar peak of 216.8 in the first half of 1948; it then declined for a year and a half; then came Korea, and costs began to rise rapidly. For the third quarter of 1951, the California index was 221.9 or more than double 1940. Available evidence as of today points to a continued upward trend.

In addition to what may be termed the normal, or periodic, rise and fall of the cost index, the Highway Commission has had other important questions before it during the preparation of its 1952-1953 budget.

The Federal Defense Program

One of these questions is the effect of the $467,000,000 which the Federal Government has announced as available for military construction in California. To a considerable extent, this large-scale construction program will represent competition for the services of highway contractors. Contractors may be expected to adopt a "wait and

see" attitude during the next few months, for a number of reasons. For one thing, a great deal depends on the speed and manner in which the Federal Government acts to obtain bids. Furthermore, these federal projects will, in themselves, tend to affect costs in California, above and beyond the action of ordinary economic forces. Still further, it may be anticipated that the protection from material shortages which goes, presumably, with a government contract may be expected to be most inviting to contractors on federal jobs.

Material Shortages—Steel

Shortages of necessary materials, potential as to some items, but very real (although, we hope, temporary) as to steel, was another of the questions which entered into the preparation of the highway budget.

The commission was well aware that the Defense Production Administration had allocated for highway purposes (that is, for the use of all levels of government—state, county, city) approximately 1 percent of the Nation's steel production, for each quarter of the year. I am advised that this allocation will supply only about 50 percent of the immediate and critical steel needs of the Nation's highways. To those of us who live day and night with the critical highway deficiencies of California, this allocation of 1 percent, in our view, is difficult to understand.

At its recent convention in Omaha, Nebraska, the American Association of State Highway Officials took up this critical problem of steel as a principal order of business. In a resolution adopted unanimously, and directed to be forwarded to all members of the Congress and appropriate federal officials, the association declared that, "the preservation of an adequate highway system is imperative, in view of the needs of national defense and the national economy." It pointed to the deficiencies in the Nation's highway plant which serves more than 50 million vehicles in the United States, and warned that these deficiencies could become aggravated to the point of paralysis of highway transport, if the curtailment of steel for highways is continued.

Finally, it urged that the essential role of the highways in the transportation of materials for national defense be "given proper recognition by increasing the allotment of steel for highway purposes to at least 2 percent of the total national production."

During World War II, as we all know, there was a tremendous concentration of defense industry and military activity in California. That pattern appears to be repeating itself, today! In California, with the continual expansion of defense plants and armed forces installations, our State Highway System is again becoming, as it was before, to a large exent a network of military access roads.

The California Highway Commission and the Department of Public Works, wholeheartedly endorse, therefore, the stand taken by the American Association of State Highway Officials on the matter of the allocation of steel for highway purposes.

In the meantime, it is hoped that some relief can be obtained through the administrative processes of the Defense Production Administration for numerous projects requiring relatively small quantities of steel. We are doing what we can in that direction.

Possible Adjustment in the Budget

Steel, as I have indicated, loomed large in the commission's consideration of next year's highway budget. In fact, it looms large in the current fiscal year as well. We are taking all possible steps to be prepared to adjust the current, as well as the future, construction program in the light of the existing situation as respects steel. If events should so require, the Division of Highways expects to be in a position to concentrate its efforts on projects requiring relatively small quantities of steel as against others which, normally, would receive prior attention when considered on the basis of need.

While such an adjustment cannot be spelled out at this time in terms of individual projects, it is obvious that grade separations, bridges, and other structures may have to be delayed unless additional steel for highways is made available. The Collier-Burns Act, which sets up our budgeting procedure will permit, we believe, for just such adjustments should such action become necessary.

I have referred to the steel shortage as "temporary." We have the assurance of Mr. Charles E. Wilson, the Nation's mobilization director, that steel production will have caught up with the current and anticipated demand by the end of 1952, barring all-out war. On the basis of this assurance, it is evident that any adjustments which may be necessary in our current construction program should not affect our thinking with regard to long-range planning. And, specifically, as respects current planning and engineering, they mean more not less. Certainly, such adjustments would not affect, in any way, the problem of highway finances. There is every reason to believe steel will be available for critical highway deficiencies before any of the current proposals would start additional funds flowing into the State Treasury.

The Question of Interim Improvements

It has been suggested the commission should, in view of the alarming traffic congestion and accident toll, resort to more interim construction measures in lieu of major improvements and freeway developments which require large expenditures and considerable time to complete.

I should like to point out in this regard that the commission, in preparing its annual budgets, has included such projects, where it was evident immediate relief and increased safety would result.

Recent examples of such projects are the widening (1950) of Sepulveda Boulevard to four lanes over the mountains between Ventura and Sunset Boulevards; the widening of the Bayshore Highway to six lanes between San Francisco and South San Francisco (a project just completed); and, the inclusion in the 1952-1953 budget of funds for widening to four lanes U. S. 101 in San Diego County between Del Mar and Encinitas.

Inclusion in the budget of projects affording temporary relief does, however, raise a question of how much money can, consistently, be diverted from permanent improvements to short-range benefits. All such proposals must be scrutinized to determine whether the immediate benefits in terms of increased safety and relief of congestion justify deferring of long-range solutions of particular highway problems.

It may well be, however, that if the highway program is to be slowed down by high prices or lack of materials, the commission may be forced to consider more of this type of work. If this eventuates, the people should understand that such diversions, perhaps fully justified as a means of cutting down serious traffic accidents, will come from construction and not from maintenance funds.

People Support Freeway Program

In considering the highway budget, we must not forget that the only facility which will provide adequate, safe traffic capacity, where high traffic volumes must be accommodated, is the freeway. The freeway offers maximum traffic capacity and maximum safety. The freeway insures that the funds provided by the motorist—his investment in the highway—will not be lost either by encroachment of roadside businesses or otherwise. As our economic studies have shown, freeways preserve and enhance existing developments and values and foster orderly community growth so essential to the economy of the State.

The experience of motorists on our expanding network of only partially completed freeways has led to a marked change in the attitude of the average citizen toward this type of highway improvement. The first freeways were viewed with extreme optimism by highway enthusiasts, but with extreme pessimism, and often bitter opposition, by many property owners and roadside proprietors. Today there is, in contrast, widespread evidence of the general acceptance of the freeway as the best solution yet worked out by highway engineers for providing safer traffic capacity while protecting the public's investment in the highway. Discussions now going on in a few places are limited, in the main, to details of location.

The highway budget for the 1952-1953 Fiscal Year, I assure you, was prepared with full cognizance of all these factors. We believe that the budget, as adopted, accomplishes, within the limitation of available funds, the expressed intention of the Legislature to provide for a highway system adequate for the transportation needs of the people. Attention at the same time has been given, where feasible, to worthy possibilities for interim relief.

We are now in the last year of the first five-year period under the Collier-Burns Act. During this period a total of $503,000,000 has been expended or obligated for state highway expansion and improvement. The expenditure of this half billion dollars represents 2,800 miles of new or rebuilt highway, including 530 miles of divided, multilane construction. Outstanding progress has been made on freeway projects in the Los Angeles metropolitan area; on U. S. 99 between Los Angeles and Sacramento; on U. S. 101, the Coast Highway; on projects in the San Francisco Bay Area; and on U. S. 40 between San Francisco and Sacramento, and beyond.

The development has been orderly, progressive, and, insofar as possible, in accordance with relative needs. Unfortunately, the rate of progress, due to increased costs, is falling behind the schedule anticipated at the time of passage of the act in 1947.

I cannot say to you, the outlook is encouraging; for it is now obvious that, with current revenue, it will be many years before we can hope to complete improvement of the State Highway System to a standard adequate for the expeditious and safe movement of the traffic we now have, and which we can, with reasonable accuracy, predict for the future. It would seem that the only answer to the demand for early alleviation of the present congestion and accident-inducing conditions, is additional funds. But this is the problem of the people of California and their Legislature, not the Highway Commission.

Public Interest in the Highway Problem

We are, however, gratified to observe that the public is taking an increased and realistic interest in the solution of the highway deficiency problem in this State. It is encouraging that this interest is not narrow or local; that it recognizes the problem to be state-wide.

You may have noted in the press, on October 18th last, that Governor Warren received a delegation of citizens from the San Francisco Peninsula area. They had come to call his attention (and that of the State as a whole) to the serious accident rate, with high per-

. . . Continued on page 20

Richard Wilson Is Praised by U. S. Road Chief

Commendation of the work Richard H. Wilson, Assistant State Highway Engineer of the Division of Highways, has done and is doing to convince Washington of the urgent necessity for a lifting of restrictions on steel used in highway construction is expressed by Thomas H. MacDonald, Commissioner, U. S. Bureau of Public Roads, in a letter to State Highway Engineer George T. McCoy. MacDonald wrote:

Dear Mr. McCoy: After my return from Omaha I had the opportunity to talk with Mr. Clark about the steel situation. You had spoken to me briefly about it in Omaha, and this letter is to record my appreciation of the steps which you have taken in assigning this important matter to Mr. Wilson, and of the thorough work which has been done under his immediate direction in determining the steel requirements. I hope you will pass along my appreciation to him, particularly for his description of what the State is doing in the discussions. I think if we could obtain an acceptance of a similar plan of operation on the part of all the states it would put us in a position to be very much more helpful and more successful in securing steel.

One of the reasons I am sending you this letter is that last night I found that when the question was raised with the allocation authorities as to why the road program had not received an allocation commensurate with its importance, the reason given was that the information which we furnished did not adequately relate the use of the steel to the traffic service it would render. Actually, this is not a true statement as a whole, but it has been difficult to obtain the detailed evidence from all the states, so that it weakens our position. I feel certain that for some months—maybe during the whole of 1952—we will have to be in a position to supply highly detailed information, but I am certain this is the constructive approach.

New Budget

Highway Commission Sets Up Funds for Fiscal Year July 1, 1952, to June 30, 1953

FUNDS for major highway construction projects as budgeted by the California Highway Commission for the 1952-53 Fiscal Year beginning next July 1st aggregate $72,093,000.

In addition, the commission allocated $31,337,000 for acquisition of rights of way which will be required for projects contemplated in the 1953-54 Fiscal Year or succeeding programs.

For the 1951-52 or current fiscal year, the commission budgeted $78,-808,500 for major construction and $22,856,000 for rights of way, making a total of $101,664,500, as compared with a total of $103,430,000 for the next fiscal year.

The 1952-53 Fiscal Year will mark the start of the second five-year period under the provisions of the Collier-Burns Highway Act and in preparing the new budget the commission carefully checked to make certain that minimum allocations for each county as required by the Mayo amendments will be fully met.

If it becomes apparent that some of the projects included in the budget cannot be constructed because of non-availability of materials, the commission must, of necessity, substitute projects that can be built without the use of critical materials. Necessary revisions in the budget are provided for by the Collier-Burns Act.

In its 1952-53 construction budget the commission allocated upwards of $45,000,000 to continue construction of essential freeways throughout the State.

Some of the major projects financed by the new budget, including freeways, are as follows:

Alameda County, for grading and structures on 1.7 miles of U. S. 50 from the San Joaquin County line to two miles east of Redmond Overhead, $586,000. In San Joaquin County, $550,000 is allocated for grading and structures on 5.7 miles between Corral Hollow Road and the Alameda County line, providing $1,136,000 for construction on 7.4 miles of U. S. 50 east of Altamont Pass.

Alameda County, for grading and structures on the Eastshore Freeway from the Santa Clara County line to a connection with U. S. 50 near Warm Springs, $1,240,000, a length of 2.8 miles.

Alameda County, grading, paving, and structures on the Eastshore Freeway from Fallon Street to Market Street in Oakland, $1,810,00, a length of one mile.

Amador and Calaveras Counties, for grading and surfacing six miles of Sign Route 49 between Mokelumne Hill and Jackson, $450,000.

Butte County, for grading 16.5 miles of U. S. 99E from Oroville Wye to 20th Street in Chico, $835,000.

Calaveras County, for grading and surfacing portions of Sign Route 12 between the San Joaquin County line and Valley Springs, $350,000, totaling 10 miles in length.

Contra Costa County, for grading and surfacing portions of Sign Routes 21 and 24 on Main Street in Walnut Creek, from the south city limits to the north city limits of Concord, and from Danville to the Southern Pacific railroad crossing south of Walnut Creek, $200,000; length 2.5 miles.

El Dorado County, for grading and structures on portions of U. S. 50 through Placerville, a distance of 1.5 miles, $300,000. This allocation will be the start of the freeway by-passing the business district of Placerville. The structures involved are grade separations over the Southern Pacific tracks and Washington Street.

Fresno County, for grading and surfacing seven miles of Sign Route 180 from four miles east of Orange Cove Road to White Deer Road, $910,000; for a structure to carry Weber Avenue over U. S. 99 at the Belmont Subway, $110,000, a cooperative project with the City of Fresno; for replacing Whites Bridge on Sign Route 180, $100,000.

Glenn County, for widening Stony Creek Bridge on U. S. 99W, $120,000.

Humboldt County, for grading 2.9 miles of the Burns Freeway on U. S. 101 from Gannon Slough to 0.9 mile north of Arcata, $600,000.

Imperial County, for grading, surfacing, and bridge on two miles of U. S. 99 from the south city limits of Brawley to 1.1 miles west of Brawley, $440,000.

Kern County, for widening portions totaling 1.2 miles on Grocer Grade on U. S. 399, $150,000.

Lake County, for grading and surfacing 1.7 miles of Sign Route 53 from 0.4 mile south of Lower Lake to 0.3 mile north of Cache Creek, $205,000.

Lassen County, for grading, surfacing and structures on Sign Route 24 through Chilcoot Pass from Beckwourth Inn to State Route 29, $443,000; a length of 4.2 miles.

Los Angeles County, for Vignes Street Separation on Santa Ana Freeway, $400,000; for grading, paving and structures on Santa Ana Freeway from Lakewood Boulevard to Pioneer Boulevard, $3,381,000; for structures on Pomona Freeway from Covina Hills Road to San Bernardino County line, $1,625,000; for grading, paving, and structures on Colorado Freeway from Patrician Way to Kensington Place, $1,473,000; for grading, paving, and structures on Harbor and Arroyo Seco Freeways from Adobe Street to Washington Boulevard, $5,160,000; for grading, paving, and structures on Los Angeles River Freeway from 223d Street to south junction of Atlantic Avenue, $3,305,000.

Madera County, for surfacing portions of Sign Route 152 for a net length of 15.7 miles from Califa to the Merced County line, $330,000.

Mendocino County, for grading and surfacing two miles of U. S. 101 between the Northwestern Pacific Underpass and Eleven Oaks, $240,000; for construction of a culvert and fill to replace bridge at Rattlesnake Creek on U. S. 101, $400,000.

Merced County, for construction of the Merced River Bridge between Livingston and Delhi, $600,000; for construction of a new bridge and approaches across the Merced River at

Major Construction Projects in State Highway B

Cox Ferry on the Merced-Snelling highway, $275,000.

Monterey County, for grading and surfacing 5.3 miles of U. S. 101 from Chualar to Spence Underpass, $560,000; for grading, paving, and structures on the new Salinas Freeway from Market Street to North Main Street, $1,130,000.

Napa and Solano Counties, for surfacing portions of U. S. 40 from Tennessee Street on the outskirts of Vallejo to Cordelia Underpass, for a length of 5.5 miles, $300,000.

Orange County, for grading, paving, and structures on Sign Route 59 from Finley Avenue in Newport Beach to 20th Street in Costa Mesa, $700,000; for grading and paving 2.6 miles on Huntington Beach Boulevard, Sign Route 39, between U. S. 101 in Huntington Beach and Garfield Avenue, $350,000; for a new bridge across the Santa Ana River on Sign Route 14, $500,000.

Riverside County, for grading, paving, and structures on U. S. 395 from Route 64 to Nuevo Road, $850,000; for grading and surfacing two miles on Sign Route 111 east of Cathedral City, $100,000.

Sacramento County, for grading, paving, and structures from C Street in Sacramento to North Sacramento Freeway near Swanston Road, a length of 2.3 miles, $2,280,000. This project is for the construction of the superstructure and approaches of the Elvas bridge and connections to the North Sacramento Freeway at Swanston Road.

San Bernardino County, for structures on the Ramona Freeway from the Los Angeles County line to Archibald Avenue, $2,135,000, for a length of 7.2 miles.

San Diego County, for widening to four lanes the existing 5.3 mile section of U. S. 101 from Del Mar to Encinitas, $650,000; for completion of the Oceanside Freeway on U. S. 101, $2,725,000.

San Francisco, for grading, paving, and structures on the Bayshore Freeway from 16th Street to Seventh Street in San Francisco, $3,640,000, and in San Francisco and San Mateo Counties, for grading, paving, and structures on the Bayshore Freeway from Augusta Street in San Francisco to the San Mateo-Santa Clara County line, $5,500,000.

San Joaquin County, for grading and structures on 5.7 miles of U. S. 50 between Corral Hollow Road and the Alameda County line, $550,000. In Alameda County $586,000 is allocated for grading and structures on 1.7 miles from the San Joaquin County line to two miles east of Redmond Overhead, providing $1,136,000 for construction on 7.4 miles of U. S. 50 east of Altamont Pass.

San Luis Obispo County, for grading, surfacing, and structures on U. S. 101 from Marsh Street to San Luis Obispo Creek in the City of San Luis Obispo, $860,000; for grading and surfacing 6.5 miles of U. S. 101 from one mile south of Templeton to Fourth Street in Paso Robles, $860,000.

San Mateo and San Francisco Counties, for grading, paving, and structures on portions of the Bayshore Freeway between Augusta Street in San Francisco and the Santa Clara County line, $5,500,000. (See item under San Francisco County.)

San Mateo County, for surfacing 5.2 miles of the Bayshore Freeway from Colma Creek to Broadway, $310,000.

Santa Barbara County, grading, surfacing, and structures on U. S. 101 from Gaviota to Gaviota Gorge, $1,300,000.

Santa Clara County, for grading and structures on the Eastshore Freeway from Route 68 to the Alameda County line, a length of 6.1 miles, $1,960,000.

Siskiyou County, for grading and surfacing four miles of U. S. 99 from Dunsmuir to Big Canyon, $1,200,000.

Solano County, for surfacing 2.7 miles of U. S. 40 from north of Vacaville to Midway, $150,000.

Stanislaus County, for surfacing Sign Route 132 for a length of 6.7 miles (portions) from San Joaquin County line to Modesto, $350,000.

Sutter County, for grading and surfacing on Colusa Avenue through Yuba City from Onstott Road to U. S. 99, $300,000.

Tulare County, for grading and surfacing 4.8 miles of U. S. 99 from one mile north of Pixley to one mile north of Tipton, $700,000; and for paving eight miles of U. S. 99 between Tulare Airport and Tagus, $1,250,000.

Tuolumne County, for grading and surfacing eight miles on Sign Routes 49 and 120 between Stevens Bar and Groveland, $400,000.

Yolo County, for grading and paving portions of the West Sacramento Freeway from the Yolo Causeway to Tower Bridge, a length of 4.1 miles, $1,150,000.

The complete budget follows:

MAJOR CONSTRUCTION PROJECTS IN STATE HIGHWAY BUDGET FOR 1952-53 YEAR FROM JULY 1, 1952 TO JUNE 30, 1953

County	Route	Description	Approximate mileage	Estimated cost
Alameda	5 (US 50)	San Joaquin County Line to two miles east of Redmond Overhead grade and structures	1.7	$586,000
Alameda	5 (US 50)	Two miles east of Redmond Overhead to Greenville (portions), surface	3.5	175,000
Alameda	5 (US 40, 50)	Toll Plaza to West End of Distribution Structure in Oakland, surface	0.9	25,000
Alameda	69 (SR 17)	Eastshore Freeway, Santa Clara County Line to Junction with existing Route 5 near Warm Springs, grade and structures	2.8	1,240,000
Alameda	69 (SR 17)	Eastshore Freeway, Fallon Street to Market Street in Oakland, grade, pave and structures	1.0	1,810,000

SR = State Sign Route

get for 1952-53 Fiscal Year Total $72,093,000

County	Route	Description	Approximate mileage	Estimated cost
Alameda	105 (SR 17)	Old Route 69 to New Route 69 and East City Limits of Oakland to San Leandro Creek, surface and drainage	1.2	$140,000
Alameda	226	Bay Farm Island Bridge in Alameda, approaches	0.6	250,000
Alameda	227	Mountain Boulevard, Route 75 near Lake Temescal to Route 5 in Oakland, grade and surface (Joint Highway District No. 26)		300,000
Alameda	Various	Rights of Way on State Highway Routes		1,926,000
Amador—Calaveras	65 (SR 49)	Mokelumne Hill to Jackson, grade and surface	6.0	450,000
Amador	Various	Rights of Way on State Highway Routes		35,000
Butte	3 (US 99E)	At Western Drainage Canal, reconstruct bridge		10,000
Butte	3 (US 99E)	Oroville Wye to 20th Street in Chico, grade	16.5±	835,000
Butte	87	At Dry Creek, reconstruct bridge		13,000
Butte	Various	Rights of Way on State Highway Routes		75,000
Calaveras	24 (SR 12)	San Joaquin County Line to Valley Springs (portions), grade and surface	10.0±	350,000
Calaveras—Amador	65 (SR 49)	Mokelumne Hill to Jackson, grade and surface	6.0	450,000
Calaveras	Various	Rights of Way on State Highway Routes		20,000
Colusa	15 (SR 20)	Williams to Colusa (portions), surface	2.4	37,000
Colusa	88 (SR 45)	At High Ditch and Wilkens Slough, widen and redeck bridges		40,000
Colusa	Various	Rights of Way on State Highway Routes		100,000
Contra Costa	14 (US 40)	Through Rodeo, surface		80,000
Contra Costa	75, 107 (SR 21, 24)	Main Street in Walnut Creek, South City Limits to North City Limits of Concord and Danville to S. P. R. R. Crossing South of Walnut Creek (portions), grade and surface	2.5	200,000
Contra Costa	106 (SR 4)	Station 243 to Station 262, at intersection with County Road to Avon, grade and surface	0.4	80,000
Contra Costa	Various	Rights of Way on State Highway Routes		1,615,000
Del Norte	1 (US 199)	Foot of Oregon Mountain to the Oregon State Line, grade and surface	1.9	120,000
Del Norte	Various	Rights of Way on State Highway Routes		115,000
El Dorado	11 (US 50)	Through Placerville (portions), grading and structures	1.5	300,000
El Dorado	Various	Rights of Way on State Highway Routes		115,000
Fresno	4 (US 99)	Kingsburg to Fresno (portions), frontage roads and connections	9.0	56,000
Fresno	4 (US 99)	Weber Avenue at Belmont Subway in Fresno, structure and approaches (cooperative project)		110,000
Fresno	41 (SR 180)	At Kings Slough (Whites Bridge), bridge and approaches		100,000
Fresno	41 (SR 180)	Four miles east of Orange Cove Road to White Deer Road, grade and surface	7.0	910,000
Fresno	76 (SR 168)	At Fresno Irrigation District Crossing and Dog Creek, bridges and approaches		55,000
Fresno	76 (SR 168)	At Sales Creek and Dry Creek, grade, surface and structures		90,000
Fresno	Various	Rights of Way on State Highway Routes		600,000
Glenn	7 (US 99W)	At Stony Creek, widen bridge		120,000
Glenn	45	At Big Butte Creek Overflow, bridge and approaches		80,000
Humboldt	1 (US 101)	Burns Freeway, Gannon Slough to 0.9 mile north of Arcata, grade	2.9	600,000
Humboldt	Various	Rights of Way on State Highway Routes		250,000
Imperial	12 (US 80)	Coyote Wells Underpass to Plaster City (portions), surface	5.0	50,000
Imperial	26 (US 99)	South City Limits of Brawley to 1.1 miles west of Brawley, grade, surface, and structure	2.0	440,000
Imperial	27 (US 80)	East Highline Canal to Junction of Route 202, surface	11.5	150,000
Imperial	27 (US 80)	At Araz Wash, bridge and approaches		65,000
Imperial	187	At Holtville Main Drain, bridge and approaches		70,000
Imperial	187, 201	Pine Road Intersection, Orita Turn and Wiest Turn, grade and pave	1.2	102,000
Imperial	Various	Rights of Way on State Highway Routes		1,000
Inyo	23 (US 6, 395)	Kern County Line to Dunmovin (portions), grade and surface	16.7	155,000
Inyo	23, 76 (US 6, 395)	South City Limits of Bishop to Texaco Corners, grade and surface	1.4	100,000
Inyo	23 (US 395)	Texaco Corners to Mono County Line, widen 4 bridges		30,000
Inyo	212	At Amargosa River, construct dip		10,000
Inyo	Various	Rights of Way on State Highway Routes		2,500
Kern	4 (US 99)	Fort Tejon to Oak Glen, surface	2.0	50,000
Kern	4 (US 99, 466)	Bakersfield to Famoso Underpass (portions), frontage roads and connections	8.8	23,000
Kern	4 (US 99, 466)	Kern River Bridge North of Bakersfield, replace portions of Trestle with embankment	0.8	200,000
Kern	4 (US 99, 466)	Snow Road to Cawelo, frontage roads and connections		150,000
Kern	57 (US 399) (SR 166)	Grocer Grade (portions), grade and surface	1.2	150,000
Kern	58 (US 466)	0.8 mile east of Mojave to 4.3 miles east of Mojave, grade and surface	3.5	150,000
Kern	58 (US 466)	Edison Highway, Bakersfield to 1.35 miles east of Route 143, surface	4.2	90,000
Kern	Various	Rights of Way on State Highway Routes		100,000
Kings	134	Corcoran to the Tulare County Line, surface	2.6	66,000
Kings	Various	Rights of Way on State Highway Routes		100,000
Lake	15 (SR 20)	At Lucerne Creek and Deer Creek, culverts and fills		15,000
Lake	49 (SR 53)	0.4 mile south of Lower Lake to 0.3 mile north of Cache Creek, grade and surface	1.7	205,000
Lake	89 (SR 29)	At Dry Creek and Dry Creek Overflow, bridges and approaches	0.1	90,000
Lake	Various	Rights of Way on State Highway Routes		47,000

SR = State Sign Route

County	Route	Description	Approximate mileage	Estimated cost
Lassen—Plumas	21 (SR 24)	Chilcoot Pass, Beckwourth Inn to Route 29, grade, surface and structure	4.2	$443,000
Los Angeles	2 (US 101)	Santa Ana Freeway, Vignes Street separation		400,000
Los Angeles	166	Santa Ana Freeway-Lakewood Boulevard to Pioneer Boulevard, grade, pave and structures	4.7	3,381,000
Los Angeles	4 (US 6, 99)	Brighton Street to north city limits of Burbank at Cohasset Street, surface	1.0	75,000
Los Angeles	26 (US 70, 99)	Holt Avenue in Pomona from west city limits to Hamilton Boulevard, surface	0.7	85,000
Los Angeles	26	Ramona Freeway-Covina Hills Road to San Bernardino County Line, structures	7.2	1,625,000
Los Angeles	59 (SR 138)	Palmdale to Little Rock (portions), grade and surface	1.4	75,000
Los Angeles	61 (SR 2)	Angeles Crest Highway (portions), Prison Labor, grade		423,000
Los Angeles	77	East City Limits to West City Limits of San Gabriel, surface	1.2	75,000
Los Angeles	161 (US 66, Alt.)	Colorado Freeway-Patrician Way to Kensington Place (portions), grade, pave and structures	0.7	1,473,000
Los Angeles	162 (US 66)	Santa Monica Boulevard-Seward Street to Gower Street, surface	0.6	20,000
Los Angeles	165	Harbor and Arroyo Seco Freeways-Adobe Street to Washington Boulevard (portions), grade, pave and structures		5,160,000
Los Angeles	167	Los Angeles River Freeway-223d Street to south junction of Atlantic Avenue, grade, pave and structures	4.6	3,305,000
Los Angeles	167 (SR 15)	Atlantic Boulevard from Anaheim-Telegraph Road to Garvey Avenue in Monterey Park, grade and surface	4.0	207,000
Los Angeles	170 (SR 35)	Norwalk Boulevard from Slauson Avenue to Whittier Boulevard in Whittier, grade, surface and drainage		150,000
Los Angeles	174 (SR 10)	Manchester Avenue from Crenshaw Drive to Van Ness Avenue in Inglewood, surface	0.8	65,000
Los Angeles	175 (SR 14)	Redondo Beach Boulevard from Pier Avenue to Inglewood Avenue, grade and surface	1.2	155,000
Los Angeles	175 (SR 14)	Artesia Avenue from Alameda Street to Downey Avenue (portions), grade and surface	3.8	880,000
Los Angeles	175 (SR 14)	Artesia Avenue from Downey Avenue to Palo Verde Avenue, grade and surface	2.7	360,000
Los Angeles	Various	Rights of Way on State Highway Routes		13,684,000
Madera	4 (US 99)	Fresno County Line to ½ mile north of Berenda (portions), frontage roads and connections		110,000
Madera	32 (SR 152)	Califa to the Merced County Line (portions), surface	15.7	330,000
Madera	Various	Rights of Way on State Highway Routes		200,000
Marin	1 (US 101)	San Pedro Road Separation (Santa Venetia), structures		200,000
Marin	56 (SR 1)	Near Dolan's Corner, grade and surface	0.3	52,000
Marin	Various	Rights of Way on State Highway Routes		173,000
Mariposa—Tuolumne	110 (SR 132)	Stanislaus County Line to Coulterville, grade and surface	7.6	25,000
Mariposa	Various	Rights of Way on State Highway Routes		11,000
Mendocino	1 (US 101)	Northwestern Pacific Underpass to Eleven Oaks, grade and surface	2.0	240,000
Mendocino	1 (US 101)	At Ten Mile Creek, culvert and fill	0.3	75,000
Mendocino	1 (US 101)	At Rattlesnake Creek, culvert and fill	0.4	400,000
Mendocino	48 (SR 28)	Boonville to Shearing Creek (portions), grade and surface	1.3	170,000
Mendocino	48 (SR 28)	At Indian Creek, bridge and approaches		150,000
Mendocino	48 (SR 28)	At Mill Creek, reconstruct bridge		40,000
Mendocino	Various	Rights of Way on State Highway Routes		60,000
Merced	4 (US 99)	5.2 miles south of Merced to Merced, surface	5.02	320,000
Merced	4 (US 99)	Gerard Avenue to Parson Street, grade and surface frontage road	0.2	50,000
Merced	4 (US 99)	Merced River bridge		600,000
Merced	123	At Merced River (Cox Ferry), bridge and approaches		275,000
Merced	Various	Rights of Way on State Highway Routes		337,000
Modoc	73 (US 395)	Junction of Route 28 to the Oregon State Line, Prison Labor, grade and surface	33.8	330,000
Modoc	Various	Rights of Way on State Highway Routes		85,000
Mono	95 (US 395)	At Koenig Ranch, grade and surface	0.6	35,000
Mono	Various	Rights of Way on State Highway Routes		2,000
Monterey	2 (US 101)	Chualar to Spence Underpass, grade and surface	5.3	560,000
Monterey	2 (US 101)	Salinas Freeway, Market Street to North Main Street, grade, pave and structures	1.6	1,130,000
Monterey	56 (SR 1)	Replace 6 Timber Cattlepasses, and redeck Dolan Creek bridge and San Jose Creek bridge		120,000
Monterey	Various	Rights of Way on State Highway Routes		735,000
Napa—Solano	7 (US 40)	Tennessee Street to Cordelia Underpass (portions), surface	5.5	300,000
Napa	49 (SR 29)	Union Station to Yountville (portions), surface	3.0	150,000
Napa	Various	Rights of Way on State Highway Routes		115,000
Nevada	Various	Rights of Way on State Highway Routes		125,000
Orange	43 (SR 55)	Finley Avenue in Newport Beach to 20th Street in Costa Mesa, grade, pave and structures	2.3	700,000
Orange	60 (US 101 Alt.)	San Juan Creek Overflow Bridge to Dana Point, surface	1.4	46,000
Orange	64 (SR 74)	Route 2 to Riverside County Line, replace 8 cattlepasses		85,000
Orange	171 (SR 39)	Huntington Beach Boulevard, Route 60 to Garfield Avenue, grade and pave	2.6	350,000
Orange	175, 176 (SR 14)	At Santa Ana River, bridge		500,000
Orange	Various	Rights of Way on State Highway Routes		2,145,000
Placer—Sacramento	3 (US 40, 99E)	Sylvan School to Roseville, surface shoulders	3±	70,000
Placer	Various	Rights of Way on State Highway Routes		270,000
Plumas—Lassen	21 (SR 24)	Chilcoot Pass, Beckwourth Inn to Route 29, grade, surface and structure	4.2	443,000
Riverside	64 (US 60, 70)	Indio to Black Butte (portions), surface	50.0	100,000
Riverside	77, 193 (SR 71)	Ontario Avenue to north city limits of Corona, surface	2.7	100,000
Riverside	78 (SR 79)	Rockhaven Cattlepass and Lemay Cattlepass, bridges and approaches		30,000

SR = State Sign Route

County	Route	Description	Approximate mileage	Estimated cost
Riverside	78 (US 395)	Route 64 to Nuevo Road, grade, pave and structures	4.3	$850,000
Riverside	146 (US 95)	Palo Verde Lagoon, West C Canal, C-03 Canal, bridges and approaches		65,000
Riverside	187 (SR 111)	Route 64 to Cathedral City (portions), grade and surface	2.0	100,000
Riverside	Various	Rights of Way on State Highway Routes		500,500
Sacramento—Placer	3 (US 40, 99E)	Sylvan School to Roseville, surface shoulders	3±	70,000
Sacramento	11 (SR 24)	Sacramento River Bridge (Isleton) and Steamboat Slough Bridge, redeck bascule spans		75,000
Sacramento	98	C Street in Sacramento to North Sacramento Freeway near Swanston Road, grade, pave and structures	2.3	2,280,000
Sacramento	Various	Rights of Way on State Highway Routes		355,000
San Benito	2 (US 101)	At San Benito River, reconstruct bridge		160,000
San Benito	Various	Rights of Way on State Highway Routes		30,000
San Bernardino	9 (US 66)	Lytle Creek to west city limits of San Bernardino, grade and surface	0.3	35,000
San Bernardino	26 (US 70, 99)	Los Angeles County Line to Ontario, surface	2.1	90,000
San Bernardino	26 (US 70, 99)	Ramona Freeway, Los Angeles County Line to Archibald Avenue, structures	7.2	2,135,000
San Bernardino	26 (US 70, 99)	In Etiwanda, San Sevaine Channel, bridges		190,000
San Bernardino	31 (US 91, 466)	Barstow to Nevada State Line (portions), surface shoulders	42.3	235,000
San Bernardino	31 (US 91, 466)	Redecking Timber Trestle Bridges		75,000
San Bernardino	43 (SR 18)	Big Bear City to Box "S" Ranch (portions), surface	19.7	10,000
San Bernardino	58 (US 466)	Kramer Railroad Crossing, grade and surface	0.7	50,000
San Bernardino	58 (US 66)	Barstow to 1 Mile East of Daggett, grade and surface	8.1	140,000
San Bernardino	58 (US 66, 466)	Redecking Timber Trestle Bridges		240,000
San Bernardino	77 (SR 71)	Route 192 to Pipe Line Avenue, grade and surface	5.1	70,000
San Bernardino	177	Carbon Canyon Road, Orange County Line to Pipe Line Avenue, surface	5.5	60,000
San Bernardino	188	Crestline Road, Camp Seeley to Cedar Springs, grade and surface	6.7	25,000
San Bernardino	190	In Upland, Euclid Avenue to East City Limits, grade and surface	1.4	40,000
San Bernardino	Various	Rights of Way on State Highway Routes		565,000
San Diego	2 (US 101)	Balboa Avenue to Las Flores (portions), surface	6.0	150,000
San Diego	2 (US 101)	Del Mar to Encinitas, widen	5.3	650,000
San Diego	2 (US 101)	Oceanside Freeway, 2.2 Miles south of Carlsbad to Camp Pendleton Main Entrance (portions), grade, surface, and structures	4.1	2,725,000
San Diego	2 (US 101)	At Palm Avenue, grade and surface	0.6	186,000
San Diego	Various	Rights of Way on State Highway Routes		670,000
San Francisco	68 (US 40, 50)	Bayshore Freeway, 16th Street to Seventh Street in San Francisco, grade, pave and structures		3,640,000
San Francisco—San Mateo	68 (US 101, By Pass)	Bayshore Freeway, Augusta Street in San Francisco to Santa Clara County Line (portions), grade, pave, and structures		5,500,000
San Francisco	Various	Rights of Way on State Highway Routes		1,650,000
San Joaquin	5 (US 50)	Corral Hollow Road to Alameda County Line, grade and structures	6.7	550,000
San Joaquin	5 (US 50)	Janney Road to Alameda County Line (Altamont Pass), surface	4.1	50,000
San Joaquin	5 (SR 8)	At Calaveras River, bridge and approaches		55,000
San Joaquin	110 (SR 132)	Junction Route 41 to Stanislaus County Line, surface	1.3	65,000
San Joaquin	Various	Rights of Way on State Highway Routes		570,000
San Luis Obispo	2 (US 101)	In San Luis Obispo, Marsh Street to San Luis Obispo Creek, grade, surface, and structures	2.3	860,000
San Luis Obispo	2 (US 101)	One Mile south of Templeton to Fourth Street in Paso Robles, grade and surface	6.5	860,000
San Luis Obispo	2 (US 101)	Through Paso Robles, surface	2.7	190,000
San Luis Obispo	Various	Rights of Way on State Highway Routes		280,000
San Mateo	2 (US 101)	El Camino Real, 24th Avenue to 41st Avenue in San Mateo, grade and surface	1.5	110,000
San Mateo—San Francisco	68 (US 101, By Pass)	Bayshore Freeway, Augusta Street in San Francisco to Santa Clara County Line (portions), grade, pave and structures		5,500,000
San Mateo	68 (US 101, By Pass)	Bayshore Freeway, Colma Creek to Broadway, surface	5.2	310,000
San Mateo	Various	Rights of Way on State Highway Routes		147,000
Santa Barbara	2 (US 101)	Gaviota to Gaviota Gorge, grade, surface, and structure	3.1	1,300,000
Santa Barbara	56 (SR 1)	Black Road to Point Sal Road, surface	5.5	115,000
Santa Barbara	57 (SR 166)	1.7 miles east of Buckhorn Creek to 0.5 mile east of Clear Creek, grade and surface	0.4	40,000
Santa Barbara	57 (SR 166)	Three miles west of San Luis Obispo County Line to the San Luis Obispo County Line, surface	3.0	45,000
Santa Barbara	Various	Rights of Way on State Highway Routes		200,000
Santa Clara	32 (SR 152)	Pacheco Pass Road, Ferguson Road to five miles east of Gilroy (portions), surface	2.1	95,000
Santa Clara	42	0.1 mile east of Three Oaks Way to El Camino Grande and on Santa Cruz Avenue in Los Gatos, surface	1.1	90,000
Santa Clara	65 (SR 5)	Route 5 to Black Road (portions), grade and surface	1.1	25,000
Santa Clara	69 (SR 17)	Eastshore Freeway, Route 68 to the Alameda County Line, grade and structures	6.1	1,960,000

SR = State Sign Route

County	Route	Description	Approximate mileage	Estimated cost
Santa Clara	Various	Rights of Way on State Highway Routes		$646,000
Santa Cruz	56 (SR 1)	Branciforte Creek Bridge in Santa Cruz, widen bridge		60,000
Santa Cruz	116 (SR 9)	At Fall Creek, reconstruct bridge		20,000
Santa Cruz	116 (SR 9)	Boulder Creek to Waterman Gap (portions), grade and surface		200,000
Santa Cruz	Various	Rights of Way on State Highway Routes		71,000
Shasta	20 (SR 44)	At Shingle Creek, bridge and approaches		20,000
Shasta	28 (US 299)	At Montgomery Creek, bridge and approaches		80,000
Shasta	28 (US 299)	Montgomery Creek to Hillcrest (portions), surfacing		40,000
Shasta	Various	Rights of Way on State Highway Routes		100,000
Siskiyou	3 (US 99)	Dunsmuir to Big Canyon (portions), grade and surface	4.0	1,200,000
Siskiyou	46 (SR 96)	At Oak Flat Creek, bridge and approaches		55,000
Solano	7 (US 40)	Carquinez Bridge to the Vallejo Wye, surface	0.6	80,000
Solano—Napa	7 (US 40)	Tennessee Street to Cordelia Underpass (portions), surface	5.5	300,000
Solano	7 (US 40)	North of Vacaville to Midway, surface	2.7	150,000
Solano	99	At Miner Slough Bridge, reconstruct bridge		100,000
Solano	Various	Rights of Way on State Highway Routes		35,000
Sonoma	56 (SR 1)	Jenner to the Mendocino County Line (portions), grade and surface		100,000
Sonoma	208 (SR 48)	At Tolay Creek, culvert and fill		30,000
Sonoma	Various	Rights of Way on State Highway Routes		164,000
Stanislaus	41 (SR 33)	At Newman, Crows Landing and South of Westly, grade and surface	1.8	175,000
Stanislaus	110 (SR 132)	San Joaquin County Line to Modesto (portions), surface	6.7	350,000
Stanislaus	Various	Rights of Way on State Highway Routes		95,000
Sutter	15 (SR 20)	From Onstott Road through Yuba City (Colusa Avenue) to intersection of US 99, grade and surface	1.0	300,000
Sutter	Various	Rights of Way on State Highway Routes		46,000
Tehama	47 (SR 32)	At Deer Creek, bridge and approaches		85,000
Tehama	Various	Rights of Way on State Highway Routes		5,000
Trinity	20 (US 299)	Humboldt County Line to Prairie Creek, Prison Labor, grade		300,000
Trinity	20 (US 299)	Humboldt County Line to Prairie Creek (portions), base and seal coat	17±	60,000
Trinity	20 (US 299)	At Big French Creek, bridge superstructure and piers		50,000
Tulare	4 (US 99)	One mile north of Pixley to one mile south of Tipton, grade and surface	4.8	700,000
Tulare	4 (US 99)	Tulare Airport to Tagus, pave	8.0	1,250,000
Tulare	4 (US 99)	Tipton to Route 10 (portions), frontage roads and connections	15.8	39,000
Tulare	127 (SR 190)	Mile 7.0 to Mile 13.5, Bartlett Park to Clavicle, drainage and borders	6.5	100,000
Tulare	Various	Rights of Way on State Highway Routes		650,000
Tuolumne	40 (SR 49, 120)	At Dan's Creek, bridge and approaches		30,000
Tuolumne	40 (SR 49, 120)	Stevens Bar to Groveland (portions), grade and surface	8.0	400,000
Tuolumne	65 (SR 49)	At Moccasin Creek, bridge and approaches		55,000
Tuolumne—Mariposa	110 (SR 132)	Stanislaus County Line to Coulterville, grade and surface	7.6	25,000
Tuolumne	Various	Rights of Way on State Highway Routes		5,000
Ventura	2 (US 101)	Calleguas Road to Central Avenue, Camarillo grade separation		600,000
Ventura	138 (US 399)	Near Oakview Avenue to junction Route 151, grade and surface	2.3	65,000
Ventura	Various	Rights of Way on State Highway Routes		1,063,000
Yolo	6 (US 40, 99W)	West Sacramento Freeway, Yolo Causeway to Tower Bridge (portions), grade and pave	4.1	1,150,000
Yolo	50 (SR 16)	Esparto to Browns Corner (portions), surfacing and widen structures	12.7	200,000
Yolo	Various	Rights of Way on State Highway Routes		206,000
Yuba	15 (SR 20)	Hallwood Bottoms Road to Brown's Valley Road (portions), surface		30,000
Yuba	Various	Rights of Way on State Highway Routes		240,000

SR = State Sign Route

Budget Review

Continued from page 14 . . .

centage of fatalities, on the Bayshore Highway through San Mateo and Santa Clara Counties. The Governor went over the situation with them in considerable detail. He pointed out the statewide aspects of the problem and left them with a challenge; he assured them that he was ready to go along with any genuine, clearly expressed desire on the part of the people of California to speed up correction of our highway deficiencies in the one way it can be done—by an increase in highway revenues. But he insisted the demand must be real and that it must be state-wide.

In the past few weeks it has become evident the Governor's challenge to the "grass roots" has struck a responsive chord. Editorials have begun to take a state-wide view, have begun to speak right out of the impossibility of solving the problem without adequate funds, and, finally, have relayed the Governor's challenge to newspaper readers, to civic groups, and to the public as a whole.

This growing viewpoint has been effectively expressed by Mr. J. R. Paulson, managing editor of the Palo Alto *Times*, and a leader in the Bayshore Highway improvement campaign. Writing in the October issue of the *California Publisher*, Mr. Paulson points out:

"The Bayshore situation is bad. But we * * * realize that there are many other 'Bayshores' in California. Many other highways need widening, improvement and repair." After continuing with a recital of the State's overall, three-billion-dollar highway deficiency, Mr. Paulson urges his fellow editors of California newspapers to start working together in support of measures which will correct that deficiency through the building of full freeways.

And the members of the Highway Commission are especially apprecia-

. . . Continued on page 61

Stephen Chase Named to State Highway Board

Expressing regret that Homer P. Brown of Placerville was compelled to resign because of ill health, Governor Earl Warren appointed H. Stephen Chase of Sacramento to succeed the El Dorado County man on the California Highway Commission. Subject to confirmation by the Senate at the next session of the Legislature, the appointment is until January 15, 1955.

Chase, who is vice president and manager of the American Trust Company and a director of the California Western States Life Insurance Company, was born in San Jose in 1903, educated in the public schools there and was graduated from Stanford University and from the Harvard University School of Business Administration.

He went to work for the American Trust Company in 1927 after his graduation from the business school. He worked in branches of the bank in San Francisco, San Jose, Redwood City and Santa Rosa, Sonoma County, before his transfer to Sacramento in 1940.

Chase also has been active in community affairs, including service as chairman of the California War Chest campaign in 21 Northern California counties during World War II. He also has aided the Community Chest, Red Cross and other civic activities.

"Stephen Chase has an extensive background of business experience and a deep interest in community affairs which I am confident will make him an excellent Highway Commissioner," Governor Warren said.

"It is a matter of great regret that Homer Brown is unable to continue his service on the Highway Commission because of the condition of his health. He has been a fine public servant and has made a great contribution to the progress we have made in recent years in the development of our highway system."

Brown was appointed to the commission in 1943.

H. STEPHEN CHASE

State Engineer Appoints Three New Assistants

To help him cope with the expanding activities of the Division of Water Resources, State Engineer A. D. Edmonston has elevated three principal hydraulic engineers to the posts of assistant state engineers. Those promoted are: G. H. Jones, T. B. Waddell, and Gordon Zander.

Jones, who entered the employ of the Division of Water Resources in September, 1924, will have charge of Sacramento River Flood Control Project, flood damage repairs, hydraulic construction for state agencies, field surveys for state agencies, supervision of safety of dams, Sacramento-San Joaquin water supervision, snow surveys and water supply forecasts, cooperative stream gaging, contractural work for the U. S. Bureau of Reclamation.

Waddell, who entered state service with the division in August, 1913, will have charge of state-wide investigation for the Water Resources Board, cooperative investigations for the Water Resources Board, rainmaking investigations, Central Valley Project, review of federal reports, state maps and surveys and topographic mapping, irrigation and other districts, cooperative work with the soil conservation service on irrigation investigations, work for California Districts Securities Commission, Feather River Project.

Zander, who entered the employ of the State Division of Water Resources in July, 1916, will have charge of water rights applications, water rights adjudications, watermaster service, licensing of rainmakers, water quality investigations, Chapter 1552, water pollution investigations, Chapter 1549, sea water investigations, ground water investigations.

Course in Drainage Is Available to All State Road Engineers

A short course in "Drainage and Drainage Structures" is being brought during the current academic year to engineering personnel of the Division of Highways and other engineers concerned with roads and streets at 14 locations throughout the State.

Under the joint sponsorship of the Institute of Transportation and Traffic Engineering of the University of California and the University's Division of Engineering Extension, the course opened at Redding on October 12th, and will have its concluding presentation in Bishop next June.

The course is conducted by H. P. Pickering, Assistant Engineer for the I. T. T. E.

In most locations the course is made up of four three-hour meetings held on successive week ends. The subjects covered include: elements of hydrology, run-off, stream gauging; hydraulic design of culverts, inlets and outlets; hydraulics of flow in open channels; subsurface drainage; and practical design examples.

The course has already been held in Redding, Marysville, San Luis Obispo and Berkeley. Future locations and opening dates are: San Diego, January 3d; Fresno, January 18th; El Centro, February 1st; Stockton, February 15th; Los Angeles, March 7th; Eureka, March 21st; San Bernardino, April 11th; San Jose, April 25th; Bakersfield, May 9th, and Bishop, June 6th.

U.S. 50 Project

Bad Bottleneck East of Placerville Eliminated

By EDWARD F. SILVA, Jr., Resident Engineer

The recently completed project on Highway U. S. 50 from the railroad crossing east of Placerville to Five-mile Terrace was the first major construction on this section of highway since it was taken into the State Highway System. Previous improvements to this two-mile section consisted of placing base materials and resurfacing, with minor changes in alignment.

This portion of Highway 50 was one of the worst bottlenecks on the transcontinental highway leading to the great resort areas of the El Dorado National Forest and the Eastern United States.

The work done under this contract consisted of grading and placing of plant-mixed surfacing on crusher run base. The resulting improvement of alignment and sight distances will bring this section of Highway 50 to the present standards of design.

Project Two Miles Long

The completed roadway consists of two 12-foot lanes with surfaced shoulders on 68 percent of the total length and the remainder consists of four 12-foot lanes undivided. The total length of the project is two miles, averaging 5 percent grade.

Prior to the start of major construction activities, it was necessary to grade a roadbed on new alignment for the Camino, Placerville and Lake Tahoe Railroad. This was necessary to obtain an acceptable standard at the grade crossing on this project.

This view of U. S. 50 project is looking west

During construction numerous springs were encountered in the excavation and embankment areas. A total of 0.66 mile of perforated metal pipe underdrains was installed to intercept the subsurface water and stabilize the roadbed. In one unstable area it was necessary to excavate and waste over 4,000 cubic yards of material, taken to a depth of five feet, before a stable material was reached. This wasted material was of the consistency of mud.

It was in this area that boards were found three feet below the existing grade. These boards were the remains of an early corduroy road used in the early 1900's to carry the traffic of that time.

In the above area, state forces placed several perforated galvanized steel pipe horizontal drains to alleviate the sat-

ABOVE—East end of U. S. 50 Project, looking west. BELOW—Looking east, showing old highway location in right background. (Picture taken before striping)

urated condition of the area. The general geological formation was supersaturated clay and fissured lava rock.

During the placing of crusher run base it was decided to lime treat a portion of crusher run base already in place in order to decrease the plasticity index. By adding 3 percent lime, by dry weight, to the crusher run base, the plasticity index was reduced from eight to non-plastic. The lime-treated crusher run base stood up well under traffic, with very little raveling under the fast and heavy traffic carried throughout the entire construction period.

The contractor, H. Earl Parker, Incorporated, completed this project during the latter part of November, 1951. The author was the resident engineer on the project.

Photogrammetry

Aerial Photos Speed Up Highway Location and Design

By L. L. FUNK, Assistant District Engineer, District V

> Photogrammetry is defined as "the science or art of obtaining reliable measurements by means of photography."
>
> This article is based on a paper delivered by Mr. Funk at the semiannual meeting of the American Society of Photogrammetry in Sacramento on October 19th, the first such meeting to be held on the West Coast. Approximately 200 engineers and technicians participated.

HIGHWAY Location Engineers of the old school have a saying that the "windshield review" and the use of an automobile by the locator are responsible for many miles of improperly located highways. In other words, they considered it necessary to walk every foot of every possible route.

Aerial photography has made a major change in this situation. It is now possible to obtain a fairly good location without leaving the office, although we do not recommend anything quite that drastic. However, there is no doubt that the proper combination of photogrammetric products and field reconnaissance will produce a better location at a lower cost than can be obtained by the exclusive use of ground methods.

For the past few years our construction budget in District V has averaged $4,000,000 annually with an additional $1,500,000 for the purchase of new rights of way. Between 80 percent and 90 percent of our construction funds go into the four-lane development of U. S. 101 to expressway or freeway standards. We maintain two location survey parties in the field and have between 50 and 60 engineers and draftsmen working on planning and design in the office.

Early Aerial Photography

We have been users of aerial photography for over 20 years, having in our files contact prints, enlargements and mosaics, made by Fairchilds in 1929, covering 80 miles of rugged coastal area in San Luis Obispo and Monterey Counties. These photographs were used in the location of the famous Carmel-San Simeon Highway.

From 1929 to 1947 our use of aerial photography was limited to small scale photographs most of which were obtained from the Production and Marketing Administration. In 1947 we were faced with a greatly accelerated highway program, together with a severe shortage of experienced personnel. Following the example of other highway organizations, we experimented with various types of large-scale aerial photography and since that time have been consistent advocates of its use.

To understand the various types of photogrammetric products which can be used to advantage by a highway department it is necessary to know the type of highway project in which that particular organization is predominately interested.

In District V a typical project would be the development of a four-lane divided highway to interstate highway standards. Access would be limited to openings at not less than quarter-mile intervals and might be restricted entirely except at the more important crossroads. Traffic interchanges might be provided at these locations. The project would generally be from 3 to 10 miles in length and would be through terrain which might vary from level to steeply rolling. Intensity of land use could range from grazing or dry farming to built-up urban areas. It could be an entirely new alignment or portions of the existing highway could be utilized for two of the four lanes.

Construction Cost

The construction cost of such a project ranges from $300,000 to $800,000 per mile. At least 80 percent of our construction and right of way budget goes into this type of project.

In the location of a highway of this type it is seldom that cut and fill quantities are the primary consideration. Excavation rarely exceeds 25 percent and may run as low as 10 percent of the total construction cost.

If satisfactory grades can be obtained the choice between alternate routes is more likely to be a comparison of traffic service and of fitting land use patterns rather than a close fitting of the routes to the terrain to minimize grading quantities. For the study of land use aerial photographs are superior to any planimetric map and when supplemented by a few control elevations usually provide sufficient information to determine the location of this type of highway within very narrow limits. By their use we have, in nearly all cases, either entirely eliminated the preliminary survey or greatly reduced the information required from it.

Based on our past experience we would, on this typical project, use a minimum of five different sizes or scales of individual aerial photographs. These would be: contact prints from small scale photography at 1 to 20,000 with enlargements at 1,000 feet and at 400 feet per inch, and contact prints from large scale photography at a scale of either 500 feet or 300 feet per inch with enlargements from them at 200 feet per inch.

In addition to these, if the project were through urban areas or if traffic interchanges were involved we would obtain a semi-controlled mosaic, generally at 200 feet per inch, and large scale enlargements at either 50 feet or 100 feet per inch. In some instances which will be discussed more fully, photogrammetric contour maps would be obtained.

Following is a summary of our uses for the various sizes and scales of aerial photographs during the successive steps of location and design of a typical highway project:

1. For preliminary route selection we use the 1,000 feet per inch enlargements from the small scale photography. In addition to the study of land use the photographs are examined under a stereoscope to determine major topographic controls.

Patterns of land use are often an important factor in determining highway location. Aerial photographs like this one (Arroyo Grande) tell the highway planner clearly and quickly where a proposed route may or may not be feasible. Scale 1":400' on original photograph.

2. If control elevations are required they are obtained with an altimeter or by running a stadia profile using the 400 feet per inch enlargements as a base map.

3. For the study of access and the treatment of intersecting public and private roads the 400 feet per inch enlargements on which property lines have been plotted are used. On projects through highly developed areas these are supplemented by the 200 feet or 100 feet per inch enlargements for more detailed studies.

Map Scales

4. Having determined what we consider to be the best route, a map is necessary to accompany the various reports which must be made regarding the project. The most suitable scales range from 200 feet to 1,000 feet per inch depending on the type of project. Enlargements at the most appropriate scale are used for filling in topographic details on the planimetric maps.

5. If the project is an urban freeway a mosaic is prepared showing the proposed freeway lanes, ramps, connections and separation structure in colored ink. The mosaic is used in presenting the plan to our Headquarters Office, to the California

Highway Commission and to local planning authorities as well as for display at public meetings.

6. During various stages of planning and adoption of the route the project will have received considerable publicity. Either the large scale enlargements or the mosaic are the best method of explaining the proposed plan to property owners along the route who will call at our office for information.

7. If the project is on new alignment the chief of party making the location survey is supplied with 400 feet per inch enlargements from the small scale photography on which the proposed centerline has been sketched together with notes as to the various controls.

8. During the design stage following the final location survey, the drainage engineer will study the contact prints under the stereoscope and outline the drainage areas for calculation of culvert sizes.

9. The materials engineer will study the 1,000 feet per inch enlargements for the location of sources of granular materials for base and pavement construction.

10. The designer makes extensive use of the large scale enlargements. Without them his knowledge of the project would be confined to the narrow strip of topography covered by the location survey supplemented by one or two brief trips to the field. The photographs show adjacent improvements and their relation to the proposed highway and give him a general understanding of the entire project that would be impossible to obtain without their use.

11. Right of way agents make frequent use of the large scale enlargements both to determine the fair market value of property to be acquired and in negotiation for its purchase.

This vertical aerial photograph, supplemented by a relatively small amount of ground surveying, produced the contour map on the opposite page. Scale 1":400' on original photograph.

Developed by Trial and Error

Many of these various uses for aerial photographs have been developed during the past four years by trial and error and without any specialized training in photogrammetry. The field is by no means exhausted and we are constantly finding new uses or variations of the old ones. On most projects of the type discussed we would consider it poor economy not to obtain all of the various sizes and scales of photographs mentioned.

We have found that our most serious mistakes in the past have been in obtaining too few photographs rather than too many. A recent check of all projects on which we are now working in the Planning, Location and Design sections showed that we are using aerial photography on 20 out of a total of 22 projects.

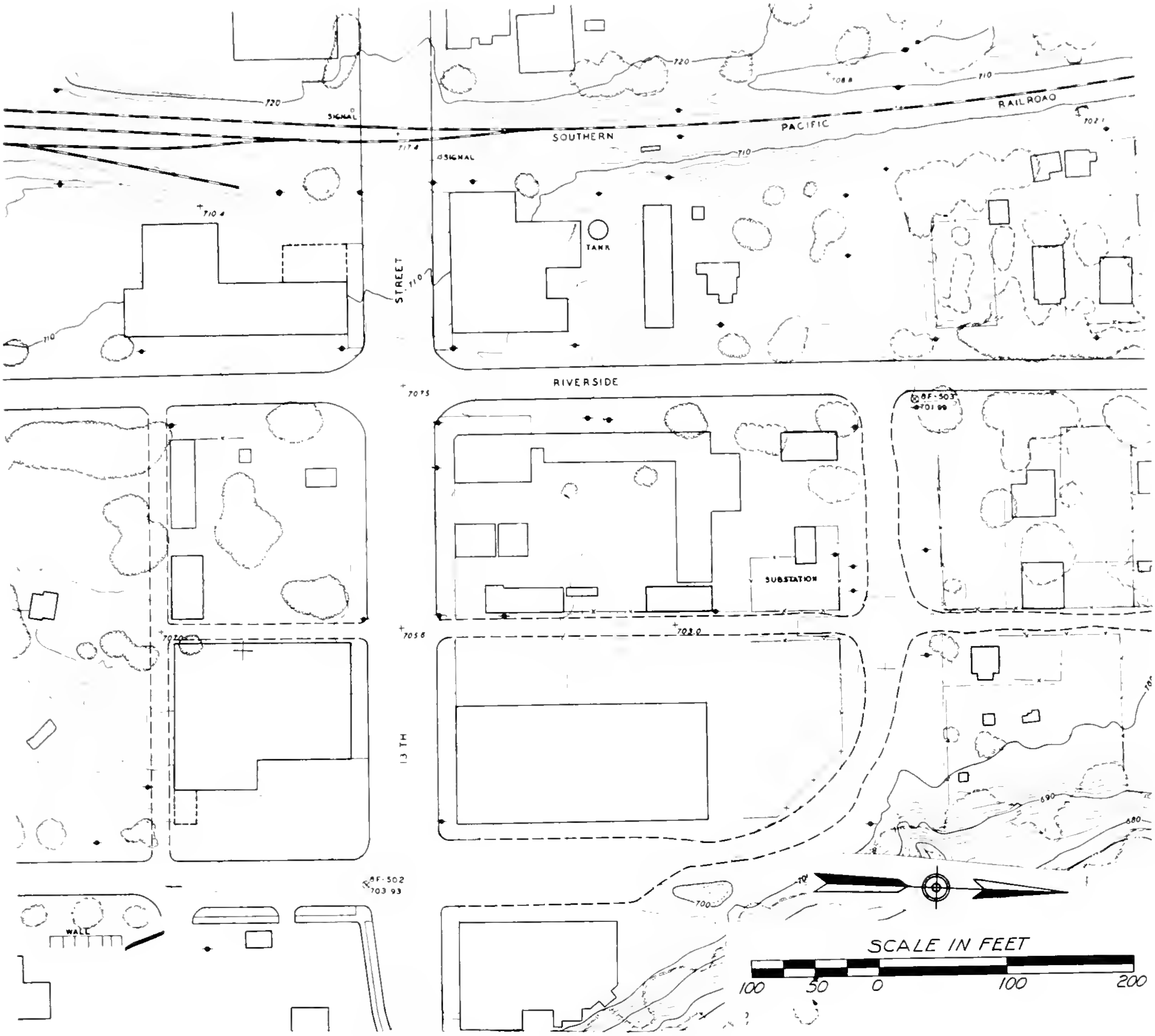
The maximum cost of aerial photography on any of our projects to date has been $175 per mile, including mosaics. The lowest cost on projects where large scale photography has been used was $60 per mile. We did not obtain mosaics on this section. It would be impossible to estimate the monetary saving that has been made. We know that the photographs have paid for themselves many times over and that we have accomplished more work and better work than would have been possible without them.

Contour Mapping

The superiority of aerial photographs over any available planimetric maps for most of the uses which have been discussed, as well as their relatively low cost, puts them in a class by themselves. In the field of photogrammetric contour mapping, however, the situation is different.

Here the photogrammetrist finds himself in direct competition with old, well established methods of making surveys for highway locations. The highway engineer will be more reluctant to experiment in this field where he must use quantitative measurements from maps whose origin is somewhat of a mystery to him. And yet there is unquestionably a large field for this type of mapping for highway location and design.

In District V we have used or have under contract photogrammetric contour maps at scales of 50 feet, 100 feet and 200 feet per inch with contour intervals of 2 feet and 5 feet. We would classify the 200-foot scale with 5-foot contour intervals as reconnaissance or preliminary survey stage maps, which would be valuable on location through steeply rolling or mountainous terrain where it was necessary to study a wide band of topography or where heavy undergrowth made it difficult to supplement the large scale photographs with ground reconnaissance. In such cases they would eliminate the need for a preliminary survey.



A portion of the area shown in the photograph on the opposite page has been reproduced in this photogrammetric contour map. Scale 1":50' on original map.

Aerial Maps Sufficient

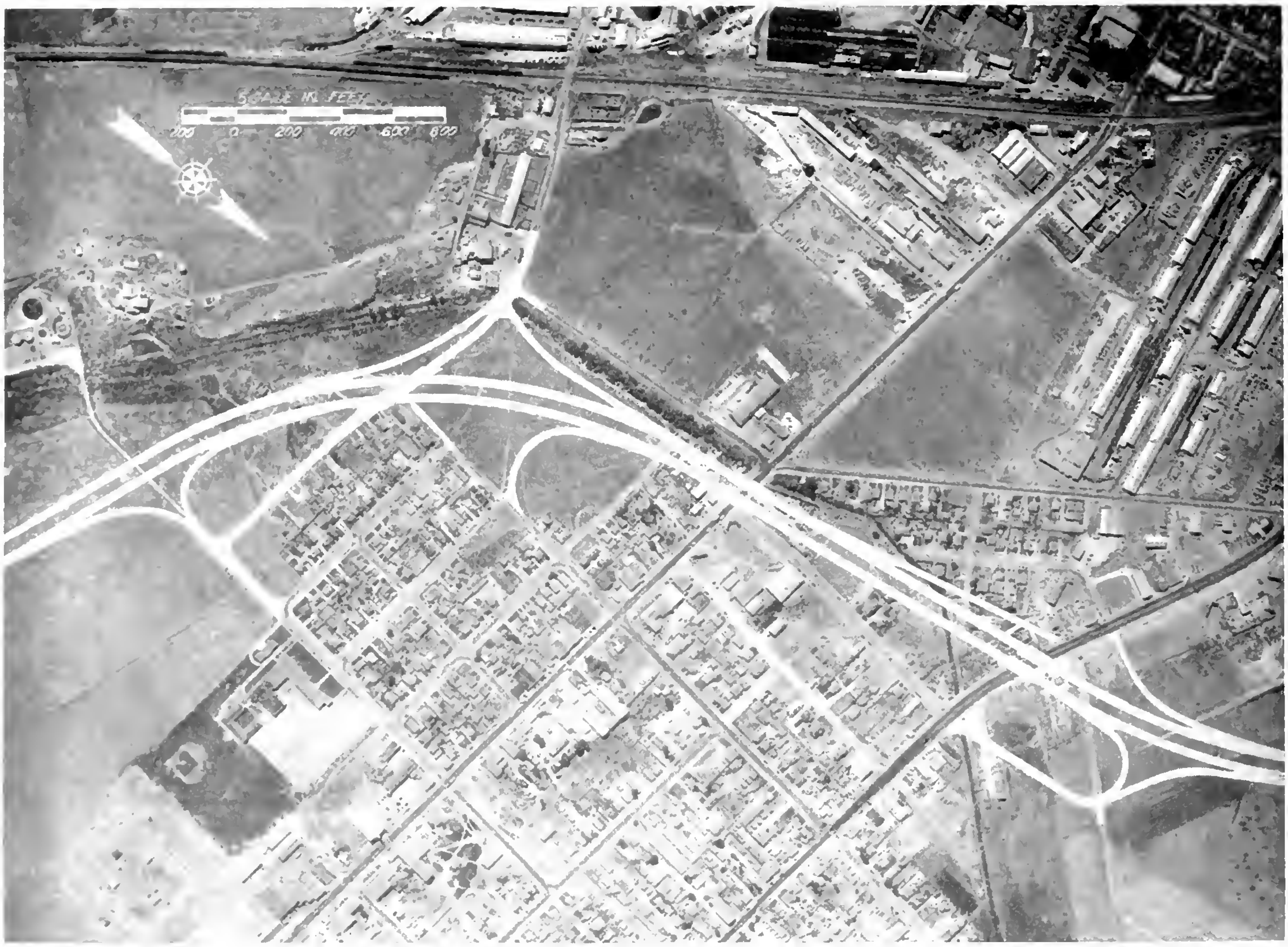
The 100 feet per inch maps with contour intervals of 5 feet or 2 feet go beyond the preliminary survey stage and greatly reduce the information required from the final location survey. Where the design is relatively simple and vegetation does not prevent accurate contouring it would be entirely feasible to develop complete construction plans and award construction contracts from the data on these maps.

Photogrammetric contour maps of 50 feet per inch with 2-foot or 1-foot contour intervals, when supplemented by a minor amount of ground surveying by our field parties, provide data for final design of the most complex highway projects. We believe that the greatest potential field for photogrammetry in highway location and design in California lies in this type of mapping. Its adaptability to one particular type of project is of special importance.

At the present time, California is embarked on a long range program of highway modernization which, on the basis of present revenue, will require many years to complete. This program will ultimately result in the development to expressway or freeway standards of practically all of our major arterial routes. It will mean relocation of many of these routes where they pass through cities, town or small suburban areas. Local communities along our principal highways are becoming increasingly aware of the probabilities of such relocations. It is only natural that they should want to know how they will be affected.

Future Planning

As an example, we were recently requested by the Board of Supervisors



A portion of the proposed Salinas Freeway is graphically shown in white ink on an aerial photographic mosaic. Scale 1":200' on original mosaic.

and local groups in Monterey County to make the necessary studies to determine the future location of U. S. 101 through all the various towns in the county. This request was made with full knowledge that construction through some of the communities was at least 5 to 10 years in the future.

There are both advantages and disadvantages to such a procedure. The obvious advantages are that it permits orderly and well integrated community planning and development and that it will result in material saving in future rights of way cost by forestalling expensive improvements which might be constructed within the next 5 to 10 years. In many cases the cost of such improvements might force us to a less desirable location in the future.

The principal disadvantage is to the individual property owner who may wish to sell or improve property which lies in the path of the future highway. By adoption of the route and the attendant publicity we have in effect put a blight on his property if he wishes to improve it or sell it. In some cases, of course, it may serve to increase its value.

Saving of Time

In all fairness to such an owner as well as to minimize future right of way costs we must be prepared to acquire such portions of the future right of way within a reasonable period of time. To do this it is necessary for us to prepare detailed plans showing all geometric features of the proposed highway including exact right of way lines. But such work requires the time of surveyors, draftsmen and designers whose services are urgently needed for projects where right of way acquisition and construction are scheduled for the next few fiscal years.

This, in our opinion, is the ideal project for the use of 50 feet per inch photogrammetric contour maps. By including key property corners in the photogrammetrist's ground control survey, we can obtain all information required for the development of plans to right of way acquisition stage with a minimum use of our own manpower. We not only save the time required for a ground survey but also most of the time required in the office to plot the survey data.

Recent Mapping Contract

This can be explained more clearly by describing our most recent photogrammetric mapping contract and the products we have obtained from it. In June of this year we contracted for maps of four highway projects totaling

16 miles in length. This included 9 miles of 100 feet per inch mapping with 5-foot contours at a cost of $940 per mile and 7 miles of 50 feet per inch mapping with 2-foot contours at an average cost of $1,670 per mile. The width of mapping ranged from 400 feet to 2,100 feet. The total contract price was $20,161.

The first maps covering 4 miles were delivered in August, an additional 8 miles in September and the last portions on October 10, four months after award of the contract. Location surveys by our usual methods for these projects would have taken one survey party over 15 months to complete and would have cost at least $45,000. Plotting the survey data would have cost another $5,000. To the $20,000 cost of the photogrammetric maps must be added approximately $3,000 for costs of checking the maps and another $2,000 for obtaining additional data not included on the maps.

Saving in Money

We have thus made a direct initial saving of approximately $25,000 and over a year in time. A portion of the initial saving will be ultimately lost as it will be necessary to run the center line prior to construction and, in order to comply with our methods of payment for excavation, it will be necessary to cross-section at least the portions of the project involving excavation quantities.

But most important is the fact that we have saved the expenditure of $45,000 worth of our own manpower at a time when the shortage of engineers is becoming increasingly critical.

The data which we will obtain from these photogrammetric contour maps is worthy of some discussion. First is the photogrammetrist's ground control survey. In conformity with recommendations of the American Congress of Surveying and Mapping, we specify modified second order accuracy for the control surveys. They are based on the State Grid Coordinate System and are adjusted to first or second order triangulation of the U. S. Coast and Geodetic Survey. These control surveys have a somewhat higher degree of accuracy than we would normally attain with our own survey parties.

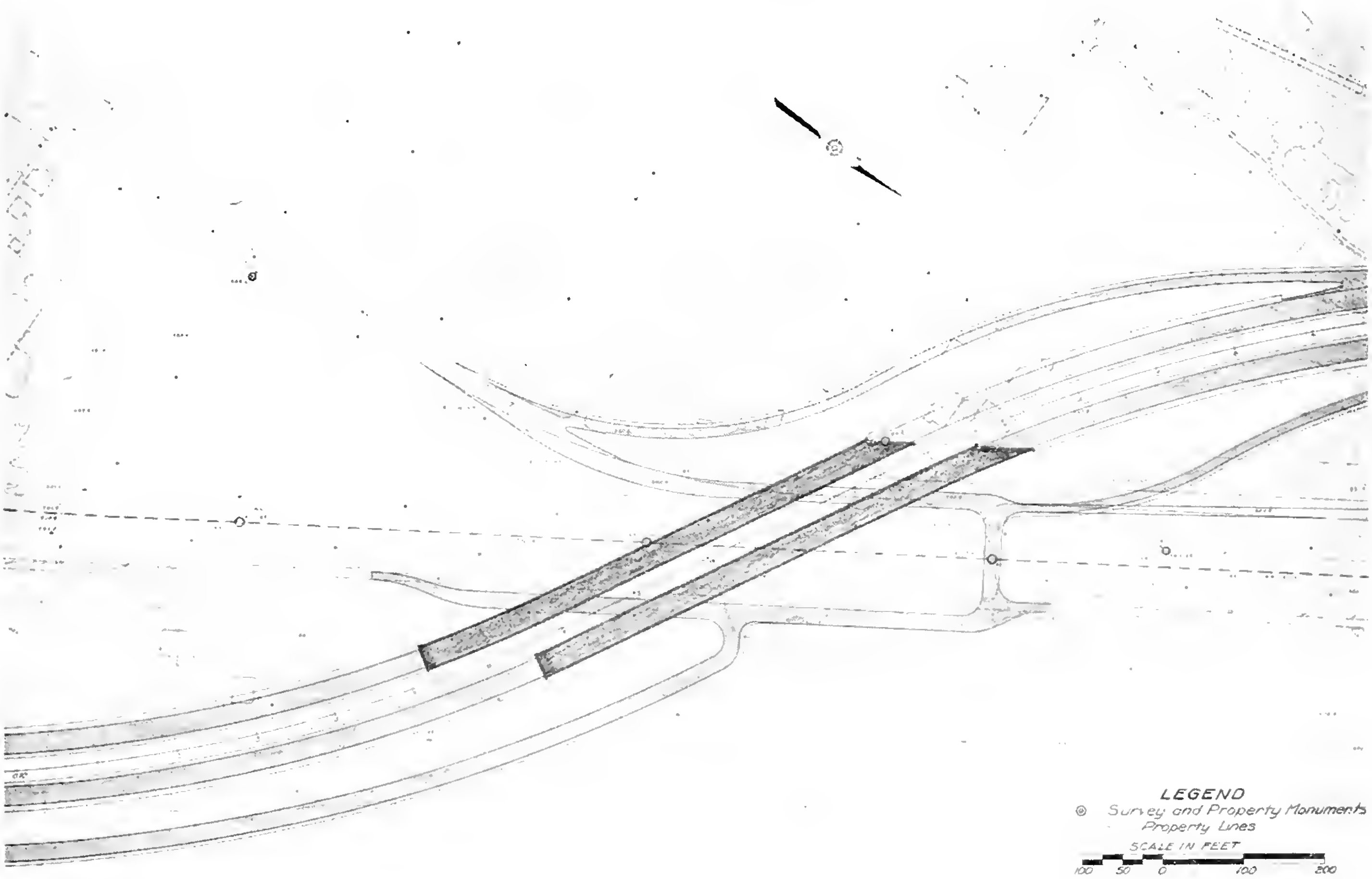
Accurate for Calculations

On the maps accompanying our specifications for the photogrammetric contract we indicate property corners, highway monuments and city street monuments which the photogrammetrist is required to locate in the course of his control surveys. As a result we are able to plot subdivisions and property lines on the maps and prepare deed descriptions with little if any additional survey work on our part.

Checks which we have made of the contouring indicate that it is suffi-

. . . Continued on page 35

For purposes of preliminary study, the design of a proposed traffic interchange has been developed in considerable detail on this photogrammetric contour map. Scale 1":50' on original map.



New Freeway

Four Units Under Way on Oceanside-Carlsbad Project

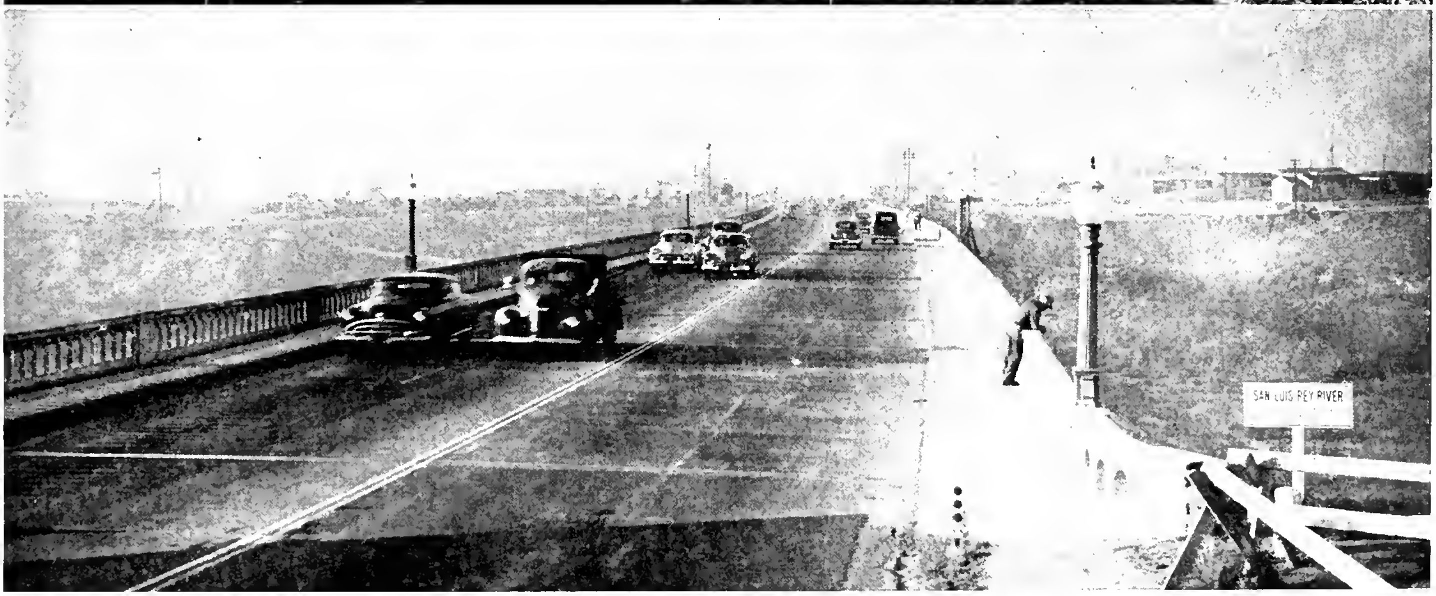
By RALPH A. LEJONHUD, Project Engineer

World War II caused a tremendous increase in population in the San Diego area. Wartime activities of the many military centers in the county flooded the area with military personnel. In addition, there was a steady civilian influx attracted by the labor demands of rapidly expanding aircraft factories and other industries. Even with wartime restrictions, this unprecedented increase in population seriously overtaxed all highway facilities as well as other utilities in the area. Contrary to popular expectations, the cessation of hostilities did not cause an appreciable decrease in population and the relaxation of restrictions on travel placed an additional burden on the highways.

High Accident Rate

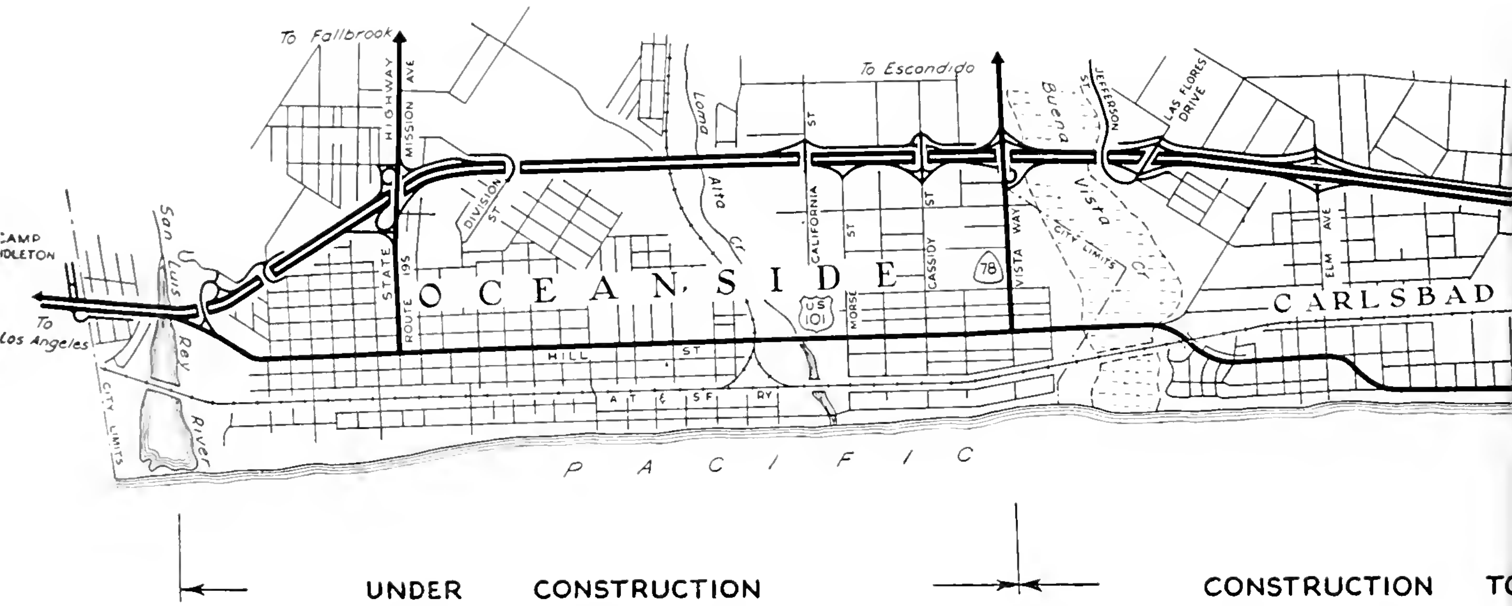
The Coast Highway, U. S. 101, is the principal connection between San Diego and Los Angeles. Between San

UPPER—Near the north end of the Oceanside-Carlsbad Freeway, looking under the Hill Street Overcrossing toward the southern (Oceanside) end of the existing bridge over the San Luis Rey River. LOWER—Looking south from the same bridge.



UPPER—Looking north across the San Luis Rey River toward Camp Pendleton from Oceanside, showing construction under way on widening of the existing bridge.

LOWER—Existing bridge over the San Luis Rey River will serve only southbound traffic when the structure is widened as a part of Oceanside Carlsbad Freeway project.



Diego and Oceanside, the present road is predominantly 30-foot three-lane pavement with some four-lane and four-lane divided sections through the unincorporated areas of Del Mar, Encinitas and Leucadia. Within the City of Oceanside, highway traffic travels the principal business street of the city. Accident rates on this section are nearly three times the state average for similar sections.

It was obvious that a major improvement was essential. In February, 1947, preliminary surveys and plans were started on the three-lane portion between San Marcos Creek and Agua Hedionda Creek as the first unit in a proposed full freeway development of the entire coast highway from San Diego to north of Oceanside. In April of 1947, the work was expanded to include a proposed relocation on full freeway standards north from Agua Hedionda through Carlsbad and the City of Oceanside to the San Luis Rey River.

Proposed as Freeway

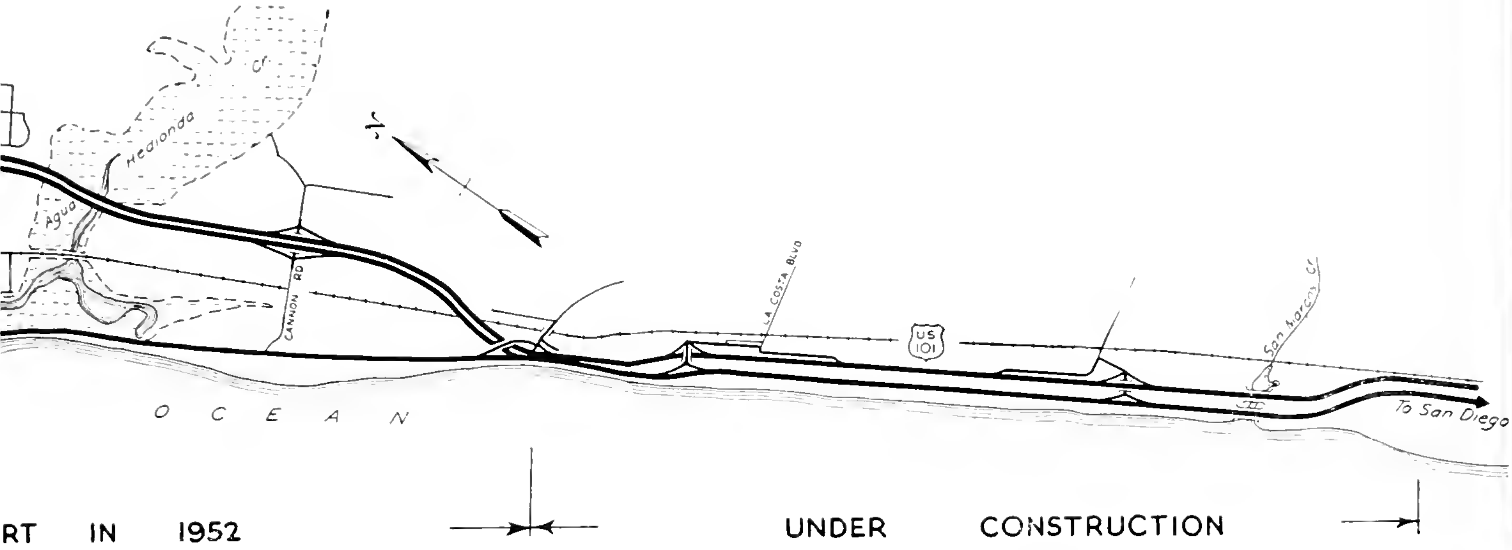
After careful consideration of all possible routes the California Highway Commission selected a route which by-passed the business districts and yet was close enough to provide adequate traffic service to the community centers.

The proposed route through Oceanside and Carlsbad was adopted and a freeway resolution passed by the California Highway Commission in September, 1949. A freeway agreement was signed with San Diego County for the portion outside the Oceanside City Limits on August 1, 1950, followed by an agreement with the City of Oceanside on August 23, 1950. In March, 1951, another freeway agreement was signed with San Diego County covering that portion of the road between 0.5 mile south of San Marcos Creek and 2.2 miles south of Carlsbad. These actions set the stage for the State to proceed with the construction.

Five Construction Units

Following completion of the agreements, the California Highway Commission promptly arranged for start of construction by allocating funds as fast

BOTTOM—Looking north, with the Mission Avenue Separation in the foreground



as detail plans were completed. Due to lack of funds, it was not possible to place under contract in the current year the section from 2.2 miles south of Carlsbad to Buena Vista Lagoon. That unit has been included in the recently announced budget for the 1952-53 Fiscal Year.

The nature of this U. S. 101 relocation does not permit utilization of any major portion until the entire project is completed. A program of independent, concurrent contracts was adopted to insure completion of the whole project in the minimum possible time.

The total project between 0.7 mile south of San Marcos Creek and the main entrance to Camp Pendleton north of Oceanside has been divided into five construction units. Four of the units are now under contract:

Four Projects Under Way

On March 15, 1951, bids were opened for the first portion of the Oceanside Freeway. This 1.06 miles section between one-quarter mile south of Mission Avenue and the San Luis Rey River was awarded to Cox Brothers. The project is under the supervision of Glenwood L. Richardson as resident engineer, with a total estimated construction cost of $1,030,000. Mr. Richardson also has general supervision of the other construction units, except for the San Luis Rey River bridge and approaches contract.

From 0.7 mile south of San Marcos Creek to 2.2 miles south of Carlsbad is also under construction by Cox Brothers, with Clarence E. Walcott as resident engineer, for a total estimated construction cost of $710,000; and

Looking south on the Oceanside-Carlsbad Freeway, showing pier construction for the Eighth Street Overcrossing in Oceanside

The San Luis Rey River Bridge and approaches are being constructed by Charles McClosky, for $1,050,000, with A. K. Gilbert of the Bridge Department as resident engineer.

The most recently awarded contract on this project covers the section from Buena Vista Lagoon to one-quarter mile south of Mission Avenue in Oceanside. The contract is held by J. A. Poyton and Bent Construction Company. Alvord C. Estep is the resident engineer. The estimated cost is about $1,734,000.

Plans are complete for the remaining unit between 2.2 miles south of Carlsbad and Buena Vista Lagoon. Bids for that work will be requested early in 1952.

Full Freeway Standards

The project is being developed on full freeway standards and incorporates the latest highway design features. The relocation through Carlsbad and Oceanside will provide two 12-foot lanes of portland cement concrete pavement on either side of a 40-foot median. Thus as traffic increases in the future, the four-lane section can be expanded with minimum expense to provide a six-lane facility with a 16-foot separation between northbound and southbound lanes.

The highway section has been adequately designed structurally to safely carry the maximum truck loads frequently encountered on this main artery. The eight-inch thickness of Portland cement concrete pavement is supported by four inches of cement treated subgrade which in turn is supported by a maximum of 16 inches of selected material. Thus the native material is covered by a structural roadbed section of two feet and four inches maximum thickness.

Mud Removal

In the various sloughs crossed by the route, the existing mud and muck would not adequately support the necessary highway fills. Therefore, to prevent future settlement of the fills with resultant displacement and distortion of the highway surface, a maximum of seven feet of the existing mud and muck is being removed and replaced with suitable material.

Adequate storm drain systems are being completed as a part of the freeway construction to assure the rapid removal of all storm waters for the protection of the traveling public. Nearly eight miles of various size pipes are being installed for culverts and storm drains in addition to the more than four miles of piping required for sewer and water supply relocations and sprinkler systems. Portland cement concrete gutters are being constructed adjacent to the main traffic lanes in urban areas to remove surface water. The gutter sections will also serve to confine traffic to the main lanes, thus reserving shoulder areas for emergency use.

Erosion Control

All excavation and fill areas are being covered with top soil as a part of the current work. Following the present construction operations, ornamental plantings and ground cover will be started for erosion control and landscaping.

From 0.7 mile south of San Marcos Creek to 2.2 miles south of Carlsbad, the existing road will be used to serve southbound traffic and two new lanes are being constructed to serve northbound traffic. Separation of the traffic lanes in this area will vary from a minimum of 48 feet to approximately 240 feet, due to slight differences in alignment between the existing road and the new construction.

To provide access control, all of the property west of the highway between the approximate limits of San Marcos Creek and 2.2 miles south of Carlsbad is being acquired in connection with the current project. In the disposal of any of this ocean front property found to be in excess of actual highway needs, first consideration will be given its development for recreational purposes by appropriate public agency.

The complete project represents a length of 11.3 miles with a total cost of construction plus rights of way of approximately $8,800,000.

GOOD WALKING HABITS

Don't be a jaywalker. Cross streets at the crosswalk, not in the middle of the block. And watch the traffic lights. Walking's good for you, but watch *where* you're walking.

In Memoriam

FRED W. HASELWOOD

Friends of Fred W. Haselwood were shocked and saddened to learn of his death at Redding on November 20 ,1951. It was only a year and a half ago in May that he left state service with the best wishes of his friends and coworkers, that he might have many years of enjoyable retirement.

Fred Haselwood would be ranked among the leaders of the small group of engineers who, in 1912, laid the foundation of the highway network and engineering organization of California, that has to this day been rated with the highest in the Nation. It was their unquestioned engineering ability, absolute honesty, and unrelenting resistance to any damaging influence, that carried the organization through the years with the highest respect of all, and without one single charge of corruption.

It was Fred's inherent ability to foresee the needs of the future that made his work outstanding, and he gave without personal thought of his time and effort to obtain perfection in his chosen field. Of him it can truthfully be said that "He served the people well."

Fred is survived by his devoted widow, Maude Zimmerman Haselwood, his son Robert, and three grandsons, Richard, Robert, and Douglas.

Sincerest sympathy of all is extended to the family.

NEW MEXICAN HIGHWAY TO OPEN NEXT YEAR

Mexico's new Pacific Highway, designed to link Nogales, Arizona, with Mexico City, is well under way and is expected to be completed in mid-1952, according to announcement made by the Automobile Club of Southern California.

About 1,200 miles of highway are now completed, the principal points along the way being Cuidad Obregon, Mazatlan and Culiacan. In four years of construction, 96 bridges, totaling 25 miles, have been erected. It is expected that this new highway, when completed, will take some 450,000 American visitors annually to Mexico City.

Photogrammetry

Continued from page 29 . . .

ciently accurate for calculation of excavation and embankment quantities and for establishment of slope lines and subsequent calculation of right of way lines. On the 9 miles of 100 feet per inch mapping we have run check profiles which cross 455 of the 5-foot contours. Slightly over 90 percent were in error by less than 2.5 feet and 52.5 percent were in error by less than 1.0 foot.

A tabulation of errors in half-foot groups shows close conformity to the theoretical error curve with the number of plus and minus errors being approximately the same in each group. Checks made to date on a portion of the 50 feet per inch mapping with 2-foot contour intervals indicate that over 60 percent of the contours are in error by less than 0.5 foot with plus and minus errors again being approximately equal.

Checking Worth While

This may seem to be an excessive amount of checking but we believe it to be well worth while. It has satisfied us that systematic errors have been eliminated in the various photogrammetric processes and gives us a feeling of confidence in the maps.

Cultural detail is not quite as complete on these maps as we would obtain from our own surveys, but is sufficient for right of way appraisal and acquisition. We would not plan to cut 10 feet off the front of a building or place the right of way line within a few feet of a well or other valuable improvement by scaling from the maps without a field check. However, we would, in similar cases, make an additional check of our own ground survey measurements.

Where connections are to be provided to existing streets or roads or where separation structures are provided at such locations it will be necessary for us to determine more accurate elevations in the field. We will have to locate culverts, septic tanks, and various underground utilities in the field. At locations where second story or pavement blankets over the existing highway are planned it will be necessary to take accurate cross-sections. However, few if any of these details are necessary for establishment of right of way lines and most of them can be postponed until a short time prior to construction.

To summarize, we have found in District V that we can make advantageous use of both large and small scale aerial photographs on nearly all of our projects. Photogrammetric contour mapping at scales ranging from 50 to 200 feet per inch possesses very decided advantages on certain specific types of highway projects. The greatest potential field in California is for highly accurate 50 feet per inch mapping with 2-foot contour interval.

Civil Defense

Continued from page 1 . . .

The field forces of the Department of Public Works will be further augmented by men and equipment from local contractors, working under the direction and supervision of our engineers through the execution of a service agreement. In case still more assistance is needed, the regional coordinator will request additional aid from adjacent areas not having suffered enemy attack.

Generally, the responsibilities that will be assigned to our department forces will be in conformity with our normal duties. For example, the first responsibility of Division of Highways employees will be to head up certain "debris clearance" teams to clear lines of communication (highways, roads and streets) of obstructions. The Division of Architecture will likely furnish "damage survey" teams to a stricken area, to determine those buildings and other structures that can still be used or that must be demolished because they are unsafe. The Division of Water Resources will be actively concerned with weakened dams within the area affected, and with the adequacy of the water supply. All of these duties have been set out and studied in the individual plans of the operating divisions, so that they are foreseen and expected to a degree that little or no realignment of our forces has been necessary to establish full conformity with the State Civil Defense Plan.

We are constantly experiencing situations that test the efficiency of the

. . . Continued on page 63

John K. Hislop Gets New Post

Appointment of John K. Hislop of Los Angeles as manager of the San Joaquin Valley Council of the California State Chamber of Commerce has been announced by James Mussatti, general manager.

Hislop, formerly assistant manager of the State Chamber's Southern California District Council, succeeds Paul Fairchild. He took over his new duties November 15. The San Joaquin Valley Council offices are located in the Fresno Hotel, Fresno.

A native of Los Angeles, Hislop attended the University of California at Los Angeles. Following service with the Navy during World War II, Hislop joined the State Chamber staff as director of public relations for the Southern California district. He later became assistant manager of the Southern California office.

Counties Share In Forest Funds

More than $2,250,000 will be distributed among counties of California containing national forest land as their share in national forest receipts for the last fiscal year which ended June 30th. These estimates of amounts to be distributed have just been released by Regional Forester Clare Hendee of the Forest Service with headquarters in San Francisco.

This amount, $2,340,742, represents an increase of about 138 percent over the last fiscal year's returns to the counties. This increase is the result of higher prices for some national forest products and the opening up of new areas for fuller utilization of previously undeveloped areas. Current receipts indicate that next year's returns will go even higher. New record highs will probably be established in most of the counties concerned.

Every year, 25 percent of each national forest's total earnings is divided among the counties in which a national forest is located. The division is made in proportion to the percentage of national forest land within each county. All moneys received by the various counties is used for roads and schools.

Gaviota Pass

Tunnel Work to Provide 4-Lane Highway Under Way

J. E. ECKHARDT, Design Engineer, District V

In Gaviota Gorge, 32 miles northerly from the City of Santa Barbara on U. S. 101, there is an historical monument to an event that didn't happen. Inscribed on this monument is the following: *"Here on Christmas Day in 1846 natives and soldiers from the Presidio of Santa Barbara lay in ambush for Lt. Col. John C. Fremont, U. S. A., and his battalion. Advised of the plot, Fremont was guided over the San Marcos Pass by Benjamin Foxen and his son, William, and captured Santa Barbara without bloodshed."*

Gaviota Canyon traverses the Santa Ynez Range from north to south across the structural trend of the range. During the process of downcutting, Gaviota Creek and its tributaries aided by differential erosion on steep-dipping strata has dissected the canyon into a rugged terrain of V-shaped canyons trending east-west with sharp divides over 600 feet high.

Geological Formation

Rainfall averages about 20 inches and the erosional effects from runoff are very slight on the hard resistant sandstones but in the areas underlain by shale and siltstone, canyons have developed.

The Santa Ynez Mountains comprise a portion of an east-west range which in this area were formed by a raising of the earth's crust with the various layers dipping to the south.

Within the limits of the tunnel the formation is Gaviota sandstone in massive formations.

Geologically speaking, the formation of this area is very young, being formed only about 40,000,000 years ago.

Because of the historical importance and natural rugged beauty of this gorge every effort is being made in connection with the development of a four-lane expressway of U. S. 101 through this area to hold to a minimum the scar that man and his machinery will make. Further efforts in the form of landscaping will be made to obscure the workings and repair the damages of the highway contractors and the highway engineers.

As part of this plan a 420-foot tunnel is being constructed in lieu of an open cut at the narrowest point in the gorge. The tunnel will be on a 1,200-foot radius curve, on a +4.47 percent grade, and will provide for two lanes of travel for northbound traffic with the existing two-lane highway being used for southbound traffic.

Tunnel Construction

The tunnel is to be lined with 1 foot 6 inches of Portland cement concrete and will be horseshoe in shape, approximately 35 feet wide and 22 feet high. To handle possible subsurface flows, arch weepers constructed of 3-inch steel tubing are to be placed about every 30 feet along each side of the tunnel, 6-inch perforated metal pipes are to be placed near the base of the tunnel on each side at 15-foot centers, and a 6-inch pervious material blanket is to be placed under the cement concrete pavement. These will all drain into longitudinal openings to be constructed along each side of the tunnel in back of the curbs.

Provision is to be made for future lighting of the tunnel in the event it is found necessary at a later date. This will consist of the conduit, transformer boxes and other parts to be embedded in the concrete lining.

To further preserve the natural beauty of the Gorge every effort is to be made to blend the exposed portions of the tunnel with the surrounding landscape. The exposed surfaces of the tunnel portals are to be finished to simulate the native sandstone of the Gorge. Rough form lumber with the unfinished surface in contact with the concrete, with recesses formed in the concrete and an application of a sandstone colored stain will produce a concrete surface with the appearance of large blocks of sandstone. The stain will be darker in the lower portions of the portals and around the edge of the tunnel opening. A portion of the tunnel barrel near the north portal will be exposed due to the nearly vertical slope of the ridge and a 20-foot overhang. This surface will be finished in the same manner as the tunnel portals with an area on top to be backfilled with topsoil. This area and a small daylighted area just north and to the left of the north portal are to be planted with native shrubs and trees to further restore the natural appearance of the Gorge.

Landscaping

Several hundred feet south of the tunnel a parking area is to be provided in the median which is approximately 85 feet wide. Several existing trees, including a 48-inch bay tree, are to be saved and made a part of this parking area. Additional trees and shrubs are to be provided along with other landscaping in this area as part of a separate landscaping contract. The existing bronze plaque will be moved to a sandstone pedestal to be constructed in the parking area, along with sandstone curbs to provide protection for planting and walkway areas. To further retain the natural appearance the driveway areas will not be surfaced but will have a six-inch layer of native material as a surfacing. If a steady source of water is encountered within the tunnel it will be piped to the parking area for a drinking fountain.

Bids for the tunnel contract were opened June 6, 1951, and the contract for $460,000 awarded June 18, 1951, to Rhoades-Shofner Construction Company, Inc., of Los Angeles. The contractor's superintendent on the job is Mr. Paul Lemaster and the resident engineer for the State is Mr. John E. Witte.

A time limit of 250 working days is provided with completion scheduled for July 3, 1952.

UPPER—Gaviota Pass on left. View is looking north. Tunnel borings on left. LOWER—Construction at mouth of tunnel which will provide two lanes for northbound traffic.

Boring Under Way

The contractor is required to work from the south portal only, as any hauling of material from the north portal would be across Gaviota Creek and onto the existing hgihway at a point that would be very dangerous to traffic due to the restricted sight distance on the existing lanes. Construction operations have opened up the southerly cut to the south tunnel portal and the actual boring of the tunnel proper begun. Construction is estimated at about 10 percent complete.

There is included in the engineer's estimate 12,500 cubic yards of tunnel excavation with 20,000 cubic yards of roadway excavation provided for the cuts at the portals; 1,636 cubic yards of concrete tunnel lining and 170,000 pounds of bar reinforcing steel required.

When the tunnel contract is completed and a 3.2-mile roadway contract from near Gaviota Store to Gaviota Gorge, which is budgeted for the 1952-53 Fiscal Year, is completed, a four-lane expressway, 7.5 miles in length, will replace one of the most tortuous stretches of U. S. Highway 101 between Los Angeles and San Francisco.

Shell Beach Study

Expressway Spurs Subdivision Growth

By THEODORE A. REINHARDT, Right of Way Agent, District V

Although land developers have long recognized that good highway facilities are essential to successful subdivision ventures, usually this recognition has been based on observations of general trends rather than statistics. This has been because the proper evaluation of the other factors affecting subdivision marketability is generally impossible.

A singular opportunity to measure highway benefits to a residential community depending upon a larger population center for economic support stemmed from the State's conversion of 11 miles of a crooked, steep-graded section of U. S. Highway 101 south of San Luis Obispo to a modern four-lane expressway, in connection with which about 8,000 feet of the old highway was left to serve a beachside community as a frontage road.

Moximum Effects Expected

The effects this highway improvement had on businesses along the frontage road are also noteworthy because the rough terrain dictated an extremely severe construction treatment which probably resulted in the maximum effects on commercial property to be expected in an expressway-frontage road development. The new expressway was built from 10 to 20 feet above the grade of the old highway and provides only three connections to it in approximately 8,000 feet. Furthermore, the northbound lanes are separated at intervals from the southbound by intervening land which partially obscures the highway businesses from view.

Shell Beach, 10 miles south of San Luis Obispo and near the southerly end of the expressway, is a typical rural subdivision where there is a lack of adjacent industrial development providing close-by employment. Accordingly, the unprecedented residential growth and land value increases following the highway construction are probably indicative of the importance of controlled access roads to competitive suburban and rural subdivisions throughout the State where the distance from home to office is a secondary consideration to the time and degree of safety involved in making the usual one or more round trips daily.

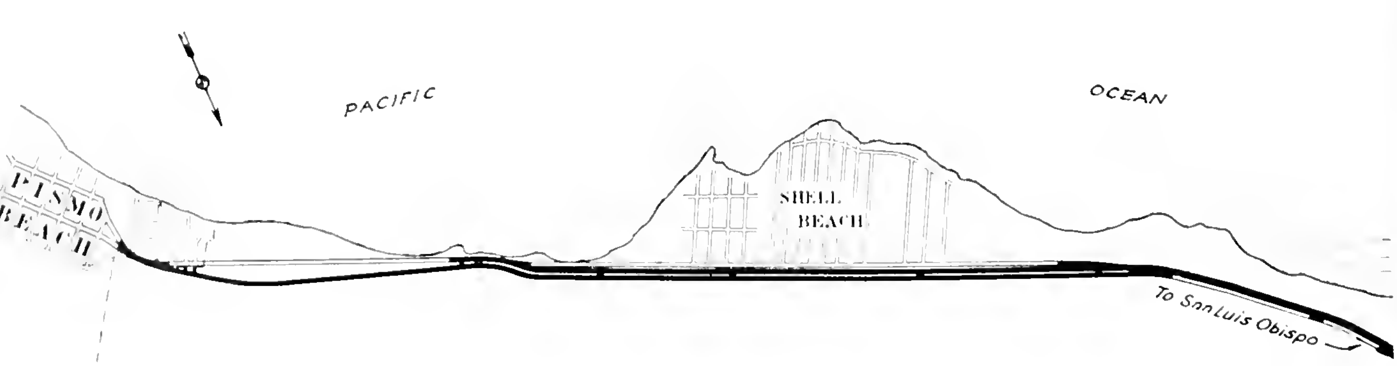
Shell Beach became a residential subdivision in 1924. Twenty-three years later, in 1947, when construction of the 11 miles of expressway south of San Luis Obispo became imminent, it was a community of less than 200 buildings and fewer than 600 people. This was despite the fact that, being located just 10 miles south of San Luis Obispo along the nearest beach to the city, the Shell Beach subdivision was ideally located for commuters who enjoy seaside living.

Growth Doubled

In these last five years Shell Beach has grown 125 percent—considerably more than double its 1947 size. During the full 10-year period from 1940 to 1950 no other community in San Luis Obispo County, including the county seat, expanded more than 60 percent, according to the latest census.

This comparison of Shell Beach growth figures with other communities in the county during the approximately five years since the expressway construction was begun points out that the Shell Beach development problem was just the question of getting the amenities of beachside living to market.

Residential property values in Shell Beach quickly reflected the increased



This map shows the communities of Shell Beach and Pismo Beach and the Southerly end of the 11-mile expressway between Pismo Beach and San Luis Obispo. Note the infrequent connections to the old road from the new divided highway.

Picture of the residential community of Shell Beach taken near the Pismo Beach city limits. The lack of a wide sandy beach explains why Shell Beach is primarily residential while Pismo Beach, with its nationally known miles of smooth, sandy beach, is almost completely tourist supported.

demand by San Luis Obispo employed families desiring seaside atmosphere following the highway improvement. These residential lot values rose from an average of approximately $400 in 1947 to an $800 average in 1950 and 1951. During this period no other existing subdivision in the area approaches this increase, percentage-wise.

Retail Business

The over-all effects of the highway improvement on Shell Beach commercial properties were slight. This conclusion was developed from a comparison of the nine previously existing Shell Beach retail businesses to the 22 establishments located along the portion of U. S. Highway 101 in Pismo Beach, one mile southerly. The Pismo Beach businesses were used for comparison because they provided the most accurate yardstick available, inasmuch as they are situated along an unchanged portion of the same highway within a mile of Shell Beach and consist of predominately the same business types—namely, cafes, bars and service stations.

Shell Beach businesses disclosed a gross volume drop of 1.91 percent during the first year after the expressway opened in the summer of 1949. Meanwhile Pismo Beach businesses along the same side of the highway dropped 5.28 percent in gross volume. Businesses on the opposite side of the highway in Pismo Beach gained 1.58 percent.

While these comparisons indicated there was very little change in the total business volume transacted by all the establishments studied, a study of the individual businesses in both Shell Beach and Pismo Beach indicated a normal amount of shifting of patronage from one establishment to another within the area.

This customary changing of patronage within the same vicinity probably accounts for the diverse opinions expressed by the business people concerning the effects of the highway improvement. The individual merchants varied in their offhand estimates from substantial benefits to severe losses.

Gains and Losses Shown

The number of gains and losses registered along the entire section, including Pismo Beach, actually were about evenly divided and did not indicate any special advantage of the Pismo Beach location over Shell Beach due to the highway construction. Five of the nine Shell Beach businesses in operation throughout the period of the study suffered varying amounts of

. . . Continued on page 64

Under a Highway

Motorists Travel Over Miles Of Pipe Lines and Conduits

By CASS M. ROSE, Senior Highway Engineer

You are driving along Lakewood Boulevard in the southeast part of Los Angeles County, and the traffic light turns red at Carson Street. As you make a 20-second pause, did you ever wonder what is under your car besides a good, dependable pavement?

Come into the District VII Substructure Section and ask the file girl that question. She will pull out a card labeled: "VII-LA-168-A" and tell you that under that particular highway intersection, crossing in several directions, and located at various depths are:

- 3 Gas lines, 8", 3", 2"
- 1 Oil line, 8"
- 1 Gasoline line, 4"
- 4 Water lines, 20", 12", 8", 6"
- 5 Telephone multiple duct lines, 2 to 6 line capacity
- 1 Power line in 2½" duct
- 1 Sanitary sewer, 8"
- 3 Traffic signal conduits
- 2 Street lighting conduits

A total of 15 pipe lines and six multiple duct lines owned by nine different companies or agencies, and this is in a rural area. Also, filed where they can be readily found, are the utility companies' maps of each of these lines.

Relocation of Utilities

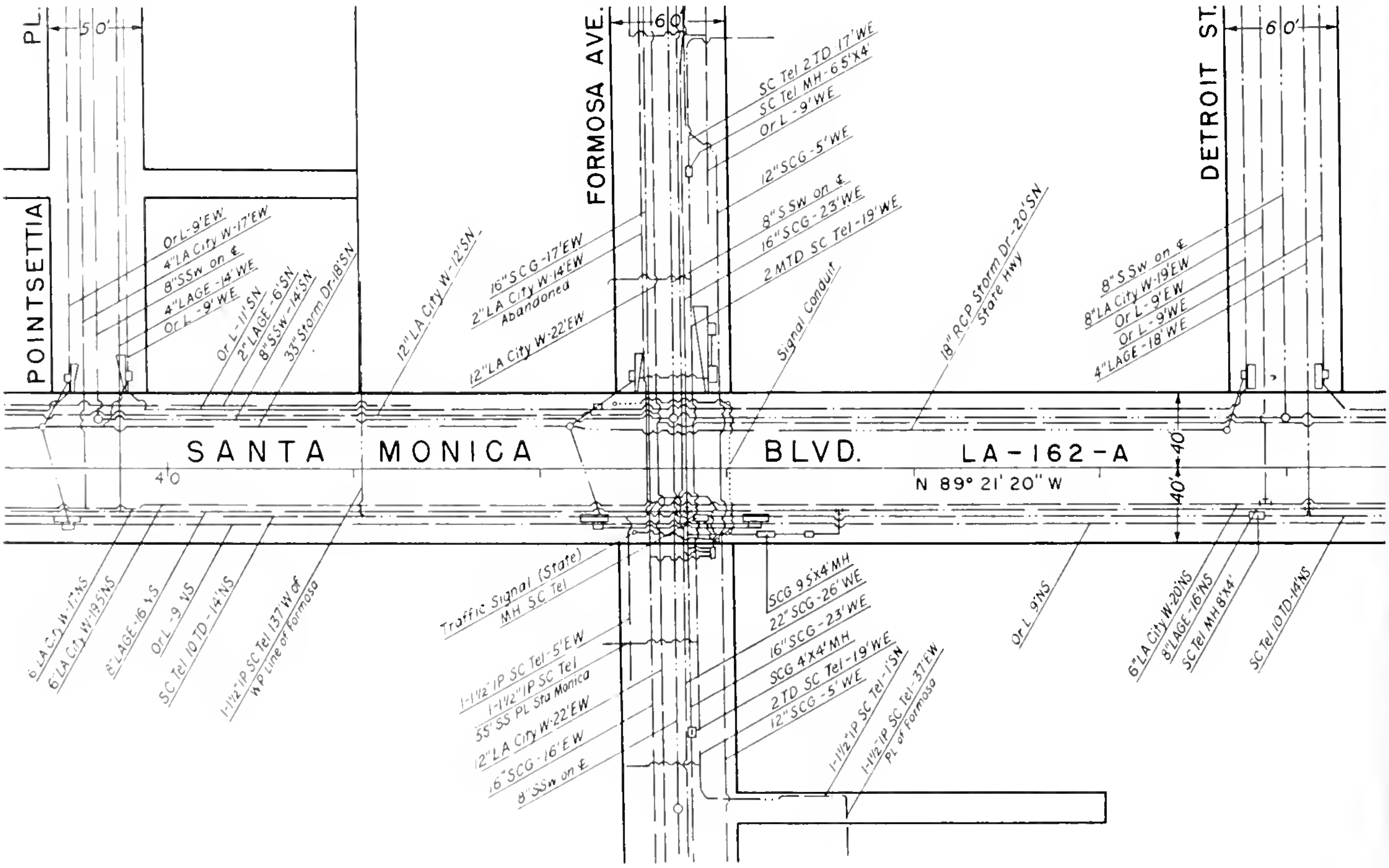
In a metropolitan area, any highway in excavation presents a major problem as to the relocation of utilities. Service cannot be interrupted; new lines must be constructed and cut in before the old lines can be abandoned.

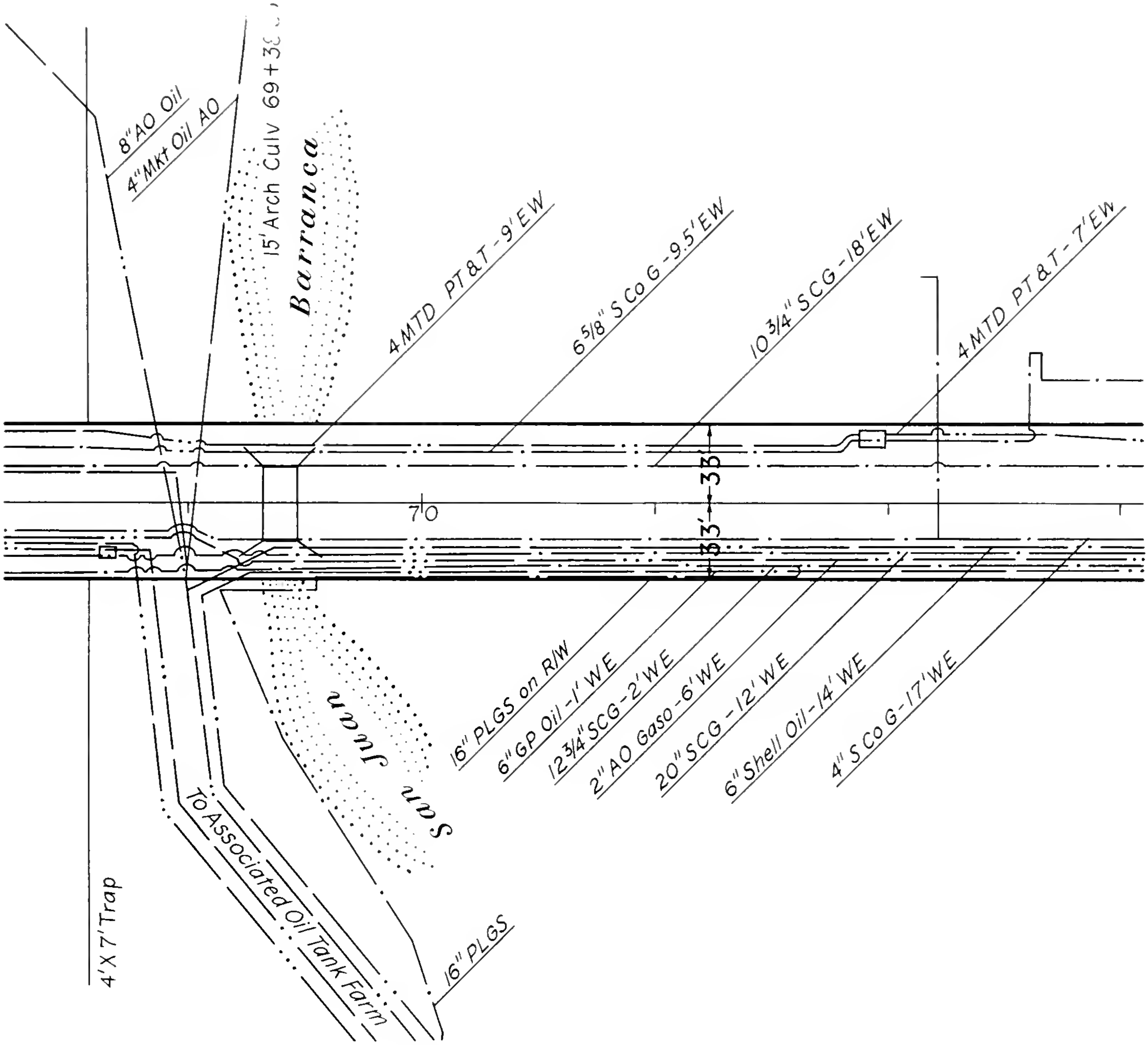
What is underground, where is it, and who does it belong to, become $64 questions, and must be answered correctly, as it is most embarrassing for all concerned when a contractor cuts a transcontinental telephone cable or a live gasoline line, which has been done in times past.

When a pipe line or lines are found during construction that are not shown on the plans, the item of removal becomes Extra Work, sometimes necessitating a change in design with considerable added cost as well as delay to the contract.

Mapping Section Set Up

District VII is endeavoring to have the answer to these questions before they are asked. A substructure mapping section was set up in January, 1951, to map all underground facilities on or adjacent to all state highways in the district, comprising Ventura, Los Angeles and Orange Counties, an area with a population of four and one-half million people. In addition to the usual utilities found in any metropolitan district, thousands of square miles of citrus groves, orchards and truck





garden farms are intensely irrigated, and some of the largest producing oil fields in the Country pipe their product to local refineries.

In the greater Los Angeles area, almost any rural highway has six or more pipe lines or ducts on or adjoining the highways, and in the vicinity of several oil fields, and at main intersections, twenty or more underground lines are not uncommon. No complete substructure map was in existence, and the only lists of underground facilities were those showing the utility companies or agencies operating under the jurisdiction of the California Public Utilities Commission.

It soon became apparent that the companies listed as "Public Utilities" were but a fraction of the total. Checking the District VII permit file for permits issued for pipe line crossings did not help clarify the picture much, since numerous lines had been laid long before many of the highways were taken into the State Highway System. Also, scattered line crossings as taken from the permits did not give the desired continuity to enable a draftsman to plot the line. "As Built" plans only showed those pipe lines that had been relaid, or those located the hard way by hitting them. That old reliable source of information, the maintenance foreman, could not be expected to know everything underground. One man proved the exception by reporting 13 pipes of various age and size encountered when excavating to install a small culvert. To date, only the owners of 11 of the pipes have been found.

Oil Companies Cooperate

Through the courtesy of the Western Oil and Gas Association, we were furnished the names and addresses of 722 oil companies in this district. All were contacted, and the response was excellent. Many were leasing, drilling or producing companies only, but some 60 companies had pipe lines, and all companies with lines on or near the state highways have now sent us maps of their pipe lines. We can now say with fair assurance that we have the location of all "live" oil and gas pipe lines in the district. Abandoned lines are a different story. Fields are pumped out, companies go out of business, or a major company revises a map and omits showing an abandoned line. When the cost of abandoned pipe line removal exceeds the salvage value, as it usually does if the pipe is on highway right of way, the pipe line is left in place and after a period of time ownership is forgotten or even denied. We have no way of mapping these abandoned lines ahead of time but this is done by a process of elimination on construction. When, during construction, live pipe lines are uncovered that have been mapped, with ownership known, any additional line or lines found are probably abandoned.

Locating Water Lines

Locating the water companies' pipe lines is even a tougher problem.

There are over 300 cities, unincorporated towns or communities in the district and 106 of them are served by 65 water companies that are listed as public utilities. The other 200 communities have a municipal, mutual or private system. From lists furnished by the State Division of Water Resources in Sacramento, by the State Bureau of Sanitary Engineering in Berkeley, and by various local water companies whose valued help is gratefully acknowledged, we believe there are over 1,500 mutual, irrigation and private water companies operating in District VII.

Each company is being contacted with a request for a map of their pipe line system if on or near a state highway, or if they have no lines affecting state highways, they are requested to inform us, so that we eventually will have a complete record showing the location and size of all water pipe lines as has been obtained in the case of the oil lines.

There are two major gas companies in the district with thousands of miles of pipe line, with service connections to practically every residential or commercial establishment. This generally means a high pressure gas line of 4 to 20 inches or larger in size on or parallel to the main highways, with four-inch or smaller low pressure service lines.

Gravity Flow Lines

The real headaches for the Design Department are the gravity flow lines, such as the sewers and storm drains, normally constructed on a very flat grade, and, unlike the pressure pipes, these lines cannot go over or under other pipe lines or obstructions. Occasionally syphons are used, but only as a last resort. One of the trunk sewers recently completed in the City of Los Angeles is 54 miles in length with a maximum size of 10 feet 6 inches in height and 12 feet 3 inches in width, having a gradient of four feet in ten thousand feet at the outfall end.

With the exception of a few rural communities which use septic tanks, all cities and towns have sewer systems, and most of these sewers in the metropolitan area flow into trunk sewers with outlets in the Pacific Ocean. Each of the 300 cities, towns and communities are being requested to furnish maps of their sewer systems, and the results obtained are as diversified as were those from the water companies, varying from towns where practically the only record is the memory of the water superintendent to others employing a fine engineering staff with all maps and records up to date.

Hydrologically, Los Angeles is situated in an area having a peculiarily intense rainfall concentration, over one inch per hour for a 24-hour period having been gaged.

Storm Drains

Metropolitan Los Angeles has over 1,400,000 dwelling units, and tens of thousands of commercial and industrial establishments, with thousands of miles of streets and other paved areas. This built up area has greatly reduced the normal percolation, and the fast runoff has resulted in flooding various districts in past years. To eliminate this condition, the city and county have constructed a network of storm drains, many being 12 feet or larger in size, and all adding to the underground congestion.

Los Angeles and the nearby cities and towns were laid out, generally speaking, without alleys and most electric light, power, telephone and telegraph lines in the streets went underground years ago, the wires or cables usually being laid in multiple ducts. As in the case of water and sewer, practically every building in Metropolitan Los Angeles is served with electricity and telephone.

The traffic signal system embraces installations at approximately six hundred intersections on state highways. To form a circuit at a normal right angle street crossing, conduits under three sides of the intersection are required. When traffic actuated signals are used, additional conduits are run from the detectors to the control box.

Many miles of ornamental street lights are in place, with separate conduit, also an elaborate police and fire signal system.

Many industries and manufacturing companies have their own water systems, as well as salt water, waste water and chemical pipe lines—all adding to the underground maze, and to the research necessary to make the underground utility mapping job complete.

All the major utility and oil companies contacted and the engineering departments of most cities and towns realize the value of a complete substructure map, and are cooperating in every respect by submitting maps of all underground utilities as they affect state highways.

Maps Available

The substructure file consists to date of over 9,000 maps, ranging from letter size to rolls 4 feet wide and 20 feet long, with all sizes in between. The information ranges from a crude lead pencil sketch showing a one-line mutual water company, exact pipe line lo-

cation and size indefinite, to carefully drafted plans numbering over 1,000 atlas sheets as were submitted by three of the major utility corporations. All maps are filed by county, route and section, with a three-way card system indexed by: (1), name of company, showing county routes and sections served; (2) county, route and section, showing utilities; (3), city or town, showing owners of all utilities operating in the city limits.

The maps being produced by the District VII Substructure Section are strip maps 18 inches in width, traced on cloth from an appropriate base map, drawn to a scale of 1 inch to 100 feet in rural areas and 1 inch to 50 feet in urban areas with intersections or points of concentrated line crossings or junctions "blown up" to an adequate scale to show the desired detail. Right-of-way, subdivision and land lines are shown, but surface topography is held to a minimum so as not to obscure underground detail.

A different symbol of dash and dot line is used for water, sewer, gas, electricity, telephone or telegraph, oil, gasoline, traffic signals, storm drains and steam lines. All lines are called out at frequent intervals showing ownership, size and location, as "6MTD-PT&T-19EW" or "18" HPG-PLG-12SN" would read "6 Multiple Tile Duct Line, Pacific Telephone & Telegraph Co., 19 feet East of the West Right of Way Line," and "18 inch High Pressure Gas Line, Pacific Lighting Gas Supply Co., 12 feet South of the North Right of Way Line." Minor companies are called out by full name.

Maps Highly Useful

To keep the maps up to date, all underground encroachment permits are turned over to the District VII Substructure Section when the construction called for in the permit is complete. Also, many of the major utility companies are submitting prints of any new lines installed by them even though on private easement if in the vicinity of a state highway.

These utility companies are beginning to realize the value of the work being done by the District VII Substructure Section, and before designing a crossing or pipe line paralleling a state highway, many of them are asking us "What's in the way?"

Like the "one-stop service station" they are finding it a lot easier, faster, cheaper and more accurate to get the information from one clearing house than to write to a dozen different sources and hope they have not missed one. They appreciate the advantage of having blueprints of the underground utilities of all companies on file in one office.

The District VII Substructure Section operates under the jurisdiction of the District Maintenance Engineer and is staffed by 10 delineators, an office assistant, and a secretary, with the writer in charge.

Highway Hi-Lites Seek Championship

TOP ROW (left to right): Evelyn Wilkerson, Maxine Struckmeyer, Marie Castro, Bonnie Simpson. FRONT ROW: Catherine Bazler, Velora Meredith, Manager, and Esther George, Gloria Artus and Jerry Wilkerson not in picture.

The Highway Hi-Lites, a basketball team organized this autumn by Ann Pratt, are entered in the State Division of the City Basketball League.

Up to the time of this writing, the Hi-Lites have lost only one game, and that was to Highway Patrol by a score of 15 to 19.

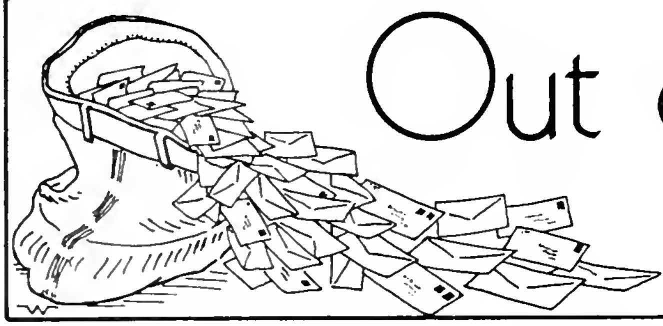
At the completion of the first half, the Hi-Lites placed second. Highway Patrol, undefeated, placed first.

The first games of the second half were played November 27, 1951.

The Hi-Lites are all out to win the league championship. Four games remain to be played.

CAN YOU STOP?

California law specifies that automobile brakes must be capable of bringing the car to a complete stop within certain distances at various speeds. A motor vehicle going 20 miles per hour should come to a complete stop within 37 feet; at 45 m.p.h., within 188 feet. This applies when driving on dry asphalt or concrete surface where the grade does not exceed 1 percent. Are your brakes good enough to make these stops?



Out of the Mail Bag

PRAISE FOR CONTRACTOR

A. TEICHERT & SON, INC.
Engineering Contractors
1846 37th Street
Sacramento 5, California

Mr. Kenneth C. Adams, *Editor*
California Highways and Public Works
P. O. Box 1499
Sacramento, California

Dear Mr. Adams: Letters like the enclosed from Mrs. Ted R. Barben, 3907 East 57th Street, Maywood, California, a member of the "traveling public," commending a contractor on a highway project instead of complaining, are so rare we thought you might like to publish it in a forthcoming issue of *California Highways and Public Works.*

Sincerely yours,
A. Teichert & Son, Inc.
By A. Teichert, Jr.
Chairman of the Board

3907 E. 57th Street
Maywood, California

A. Teichert & Son
Sacramento

Gentlemen: We recently had occasion to go over the Ridge Route to Bakersfield and knew, because of the construction work being done there, that the trip would be less than pleasant. We were delighted to find the road watered down so that aside from the surface roughness there was nothing even to complain of.

As we went for miles, I began to be so very thankful for the attention that had been paid, not only for our personal comfort but for the thoughtfulness that would reduce the severe driving hazard when clouds of dust obscure the vision. I wished I could thank someone for thinking of everything, when I saw your sign on one of the construction houses so . . . thanks very much.

Sincerely,
Mrs. Ted R. Barben

COMPLIMENT FOR C. H. HIXSON

CAMBRIA CHAMBER OF COMMERCE
Cambria, California

California Highways and Public Works
Post Office Box 1499
Sacramento, California

Gentlemen: The Cambria Chamber of Commerce does herein and hereby, go on record as having observed and fully appreciated the excellent job of maintaining the highways in this area, done by the former superintendent, C. H. Hixson. He has left a job well done and assume you have assigned another good man to carry on.

Both Mr. and Mrs. Hixson made a host of friends while here in Cambria, and it was with deep regret that we saw them leave. The community's loss will be Buellton's gain.

Several of the directors have reported on the results of the sincere efforts expended under the supervision of Mr. Hixson, which all adds up to making us proud of U. S. 101.

Needless to say, the community will extend a warm welcome to the new superintendent for this area.

Sincerely,
By Gladys V. Cooper
Secretary-Treasurer

VALUABLE TO APPRAISER

HARRY J. BLEE
Consulting Appraiser

Palos Verdes Estates

California Highways and Public Works
Post Office Box 1499
Sacramento, California

Gentlemen: Please put me on your regular mailing list to receive *California Highways and Public Works.* Much of my appraisal work has to do with acquisition of rights of way and I feel that your magazine is most valuable in that field.

Harry J. Blee

YOU ARE RIGHT

Editor

Dear Sir: Motorists in our Country are getting so pampered that they often blame their accidents on dangerous roads. The sooner they realize that no road is dangerous, that some roads are slow and others fast and require varying degrees of skill and caution to drive, that the only dangerous things about the road are themselves, the sooner we might cut down on our accidents.

Most motorists drive so fast in a fog that they are out of control if an obstruction looms up ahead. In clear weather they don't look far enough ahead to be ready for trouble when it comes. A large proportion of the fatalities come from passing unwisely, being in a foolish hurry.

The program today is to build roads that require no skill to drive over, because the 20 percent of our drivers that have over 80 percent of all the accidents have demonstrated that they have neither skill nor caution.

Doctors believe that too much sanitation, too little exposure to viruses in infancy, makes for dangerous susceptibility later on. Will fool-proof highways have the same result in accidents?

F. W. Nordhoff
Buellton, California

LIKES PHOTOGRAPHS

Mr. Kenneth C. Adams, *Editor*
Redwood City

Dear Sir: I have just paged through your recent edition on the freeways of San Francisco and Los Angeles. This is one of the most profusely illustrated highway magazines I have ever seen, and has so many articles on advanced traffic theories that are already in actual practice.

Very truly yours,
John T. Ambrose

REALTOR LIKES MAGAZINE

VENICE REALTY BOARD
Office of: Edwin A. Johnson
12234 Venice Blvd., Mar Vista
California

KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Post Office Box 1499
Sacramento, California

DEAR MR. ADAMS: I have been receiving your valued publication—*California Highways and Public Works*—for many years, and I regard it as the most important and interesting of all the magazines I receive in my office.

I have all my copies filed for future reference, and I look forward to receiving your valued publication with interest.

Yours very truly,
EDWARD A. JOHNSON, Realtor

MAGAZINE WILL BE SENT

CALIFORNIA STATE AUTOMOBILE ASSOCIATION

150 Van Ness Avenue
SAN FRANCISCO 2, CALIFORNIA

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Post Office Box 1499
Sacramento, California

DEAR MR. ADAMS: I have just had the pleasure of meeting Mr. Fernd Duperly who is the vice president of the Automobile Club of Colombia in South America.

Mr. Duperly and his father have just completed a lengthy automobile tour not only of California but of all the United States, and they have been particularly impressed with the highway system in our own State of California.

The Automobile Club of Colombia, naturally, like ourselves, is tremendously interested in the building of adequate highways in their country. They have been shown a copy of your very fine and invaluable magazine and have asked us if we would have the kindness to request that you put them on the mailing list to receive regular copies of *California Highways and Public Works.*

Yours sincerely,

CALIFORNIA STATE AUTOMOBILE ASSN.
C. H. A. DUKE,
Manager, Touring Bureau

THANKS FROM TURKEY

BRIDGE DESIGN DEPARTMENT
General Directorate of Highways
Ankara, Turkey

CALIFORNIA HIGHWAYS AND PUBLIC WORKS
P. O. Box 1499
Sacramento, California

DEAR SIRS: Since I was in California for four months, during my year long visit to your Country to study highways and bridges, I have been very much interested in all California's highways.

After returning to my country two months ago, I received two copies of *California Highways and Public Works.*

I should like to say that *California Highways and Public Works* is the best magazine, having everything about highways, for a man who wishes to keep in close touch with California's highways and highway department, where he was welcomed by everybody.

I wish to express my thanks for your mailing me *California Highways and Public Works.*

Very truly yours,
HILMI GURAYMAN
Bridge Design Department
General Directorate of Highways
Ankara, Turkey

THANK YOU

MRS. C. S. MacDONALD
1138 Talbot Avenue
Albany 6, California

KENNETH C. ADAMS, *Editor*
California Highways and Public Works
Sacramento, California

DEAR SIR: I am enclosing our "Please Renew" card, but wish to also express our appreciation of the magazine you edit. It has some of the most beautiful pictures it has been our pleasure to look at, and the text has been most informative. I better understand the problems involved in creating our beautiful highways, since reading your magazine for some years.

Our deepest thanks for sending us this magazine and may it continue for many years to come.

Yours,
MR. AND MRS. C. S. MACDONALD

APPRECIATES MAGAZINE

SCOTT and SCOTT
Research Engineering

629 South Avenue 59
Highland Park
Los Angeles 42

EDITOR K. C. ADAMS
California Highways and Public Works

DEAR MR. EDITOR: Enclosed herewith the postcard we received with the July-August issue, just at hand. Yes, we surely want continuance of our name upon your mailing list for we appreciate your journal as much as any we receive (and more than some).

We have been intending writing you our special thanks for that wonderful centennial number, received in September, 1950, for almost one year, but like so many people we know we have until now neglected doing so.

We learned so much about our adopted State from that issue that we intend keeping it indefinitely.

More and greater success to you and your staff.

Most appreciatively yours,
FRANK WILBUR
Scott-Plang, England

OUTSTANDING PUBLICATION

PET MILK COMPANY
General Offices, Arcade Building
Saint Louis 1, Missouri

Greenville, Ill.

MR. KENNETH C. ADAMS, *Editor*
California Highways and Public Works

DEAR MR. ADAMS: Through the courtesy of my brother-in-law, I was able to get copies of the *California Highways and Public Works* of which you are the editor. I have certainly enjoyed this very much and consider it a really outstanding publication.

Those of us that have lived in California for some time are really greatly interested in seeing the improvements and advances that are being made there. In addition, a number of our friends in the midwest have been greatly impressed by the information carried in your journal. Usually, material dealing with highway construction is rather heavy reading, and I think that you and your editorial staff are to be congratulated for putting out such fine readable material on the highway work of your State.

F. R. SMITH, Ph.D.
Research Laboratory

Vacuum Cleaner

New Machine Gathers Trash Motorists Throw on Highways

By W. D. SEDGWICK, Assistant District Engineer

The roadsides along many miles of state highway in District VII, particularly along the beaches and in the resort areas, look like public dumps with beer cans, bottles, ice cream cups and other trash thrown out of cars or left from roadside picnics. The state highway maintenance forces are far too few, with an average of one man to each seven miles, to attempt to keep this mess cleaned up by hand even if they did nothing else.

It was therefore considered necessary to find a mechanical method of picking up this trash. No one knew of a machine now on the market adapted to the picking up of all these items. A road magnet would pick up the cans but not the bottles and paper. It was therefore decided that a suction machine was necessary and a check of the field resulted in our locating a "Leaf and Litter Collecting Unit" manufactured by the Good Roads Machinery Company of Minerva, Ohio.

Problem of Bottles

This machine had the necessary suction capacity, as it readily sucked up bottles and cans but as it was intended only to pick up leaves and paper, everything went through the vacuum-producing fan. Bottles, even half-gallon demijohns, were pulverized and cans were cut up or smashed.

It was appreciated that the fan was not designed to stand up under the battering that thousands of bottles and cans would give it. The District VII shop forces were authorized to experiment with the machine to see what could be done to pick up the bottles and cans so they would not have to go through the fan.

In the original adaptation the suction hose, which is 10 inches in diameter, was attached to the upper end of an old hot water tank fastened above the fan with a small rectangular box below. The velocity of the heavy articles through the water tank carried them past the fan into the box and the paper and light material went through the fan into the 14-cubic-yard box, which on this machine is the same as the dirt bag on a vacuum cleaner.

Economical Operation

This arrangement worked so well that it was decided it would be worthwhile to construct an air-tight compartment in the container for the heavy materials to be trapped in. The small box required too frequent emptying to make its use an economical operation; however, when used in Superintendent Davidson's territory in Orange County, his foremen were enthusiastic about it and requested permission to clean up their worst areas before it was sent to the shop for installation of the large air-tight compartment. Even with this first arrangement, which required frequent trips to the dump to empty the small-capacity tow truck, it was found that this cleanup was

Trash on roadside on Pacific Coast Highway between Seventh Street and Anaheim Street in Long Beach area. Vacuum cleaner in operation in same location. Same location after vacuum cleaning

Opened rear gates show portion of trash that has gone through fan and lower closed airtight compartment. Operators opening lower compartment prior to raising to dump load. Dumping load shows cans and heavy trash from lower compartment.

costing much less than it had cost to clean the roadside by hand.

When we first tried it out after the air-tight compartment had been installed, we found that an appreciable portion of the vacuum was lost in the hose intake so that it would not pick up the bottles, but the Equipment Department boys would not give up. They enlarged the fan and reduced friction by making all pipe connections on curves so that now the machine easily picks up anything that will go through the reinforced flexible 10-inch hose.

Improvements Made

We first tried it out with handle bars attached to the snout and the operator walked alongside the machine swinging it back and forth. This operation proved to be too hard a job and did not give positive enough control of the snout.

We next mounted a seat near the back of the box with a footrest on which is mounted a ball. A handle bar, which swivels in a socket on this ball, is attached to the intake hose near the suction end, and with it the operator can sweep a five-foot strip, also controlling the snout elevation above the ground with the same handle bar. The end of the hose is counterbalanced with springs which make it very easy for the operator to handle it.

An electric button on the side of the box near the operator is connected to a buzzer in the cab of the tow truck for the operator to signal the truck operator when something goes wrong or plugs the hose.

Method of Operation

With the first time around, we have found that it pays to have men ahead of the machine rake the debris from the slopes and wider areas into a windrow in the ditch, and a man ahead of the suction hose to load into the tow truck the large boxes, sticks and other items that would plug the hose, so that the cleanup can progress smoothly down the road.

The District VII Shop, under the supervision of George Siebert, has done an excellent job of adapting and perfecting this piece of equipment. It is constructed so that the intake hose can be operated from either side of the box in order that litter can be picked up from central dividing strips without operating against traffic flow.

In cleaning up a particularly messy section through the Malibu on the Coast Highway, 12 loads or approximately 150 cubic yards of bottles, cans, and trash were picked up in three days.

The machine was used to pick up puncture vines from the roadside on

Vacuum cleaner with tow truck loaded with oversize trash, showing operator's seat, handle bar with ball-and-socket joint for controlling snout. Operator is pushing button to buzzer in tow truck cab.

Vacuum Cleaner

Continued from page 47 . . .

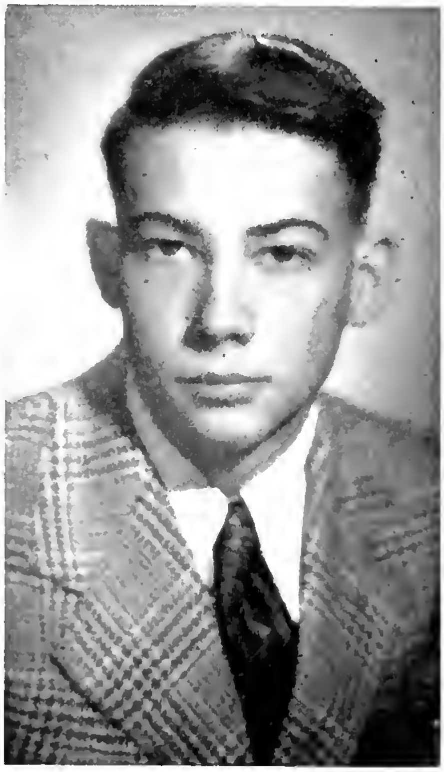
the Laguna Canyon road. Most of the burrs had developed and the vines had dried before the Orange County Horticulture Department had sprayed them in this area. A large percentage of the burrs had fallen off the vines and picking them up would have been a practical impossibility without this machine. The only preparatory hand work necessary for this operation was to cut the main root of the vine with a hoe. The machine did a very clean job of picking up the vines and loose burrs quickly and efficiently.

Movies of this machine in operation are now being prepared to be available to show service clubs, parent-teacher meetings and other groups. Showing of this film should impress the people that they should not make our streets and highways a public dump with the mess that they now throw out their windows for the overloaded maintenance man to pick up.

Closeup of operator and push-button mechanism →

In Memoriam

HARLAN L. STEPP



Friends and co-workers were shocked to learn that Harlan L. Stepp, formerly with the Highway Planning Survey, was killed in action in Korea on October 14, 1951. He was hit by artillery shrapnel while fighting near Kumsong.

His father, Mr. Ray Stepp of Likely, Modoc County, was notified by the Adjutant General of the Army which information was later confirmed by a letter of condolence from General of the Army M. B. Ridgeway.

Harlan was born May 25, 1929 at Durham, California, and lived most of his life in Likely, Modoc County. He was graduated from the Modoc Union High School in 1947 and attended one year the California School of Mechanical Arts, in San Francisco.

On October 1, 1950, he was appointed Under Engineering Aid with the Highway Planning Survey with which department he worked until he was inducted into the Armed Forces on February 28, 1951. He took his basic training at Camp Roberts and shipped to Far Eastern Command on July 25, 1951.

At the time of his death he was a p.f.c. with Co. C, 1st Bn., 19th Inf. Regt. 24th Inf. Div. His parents, Mr. and Mrs. Ray Stepp of Likely, Modoc County, survive him.

Harlan was well liked by his fellow workers and made many friends in the short period of his employment with the Highway Planning Survey. They join the department in extending their profound sympathy to the family.

Hatchet Mountain

First Unit of Line Change on Shasta Road Completed

By W. H. BARTLETT, Resident Engineer

Hatchet Mountain remains the last major obstacle in the improvement of U. S. Highway 299 through the Pit River watershed in eastern Shasta County, a distance of 16 miles.

Work on the first section was started in October, 1950, and is now complete. The project was 1.6 miles long and encompassed the crossing of Hatchet Creek with improved alignment and grade. The old highway was narrow and crooked and in some places hard for big trucks to travel over with any speed without accident. Hatchet Creek Bridge was located at nearly right angles to the stream and the approaches were built to fit the bridge and the contour of the ground. With the improvement of this section, work can now be started on another part of the programmed projects over the mountain.

Early Day Travel

The history of travel over Hatchet Mountain is one of courage and pioneer spirit in the building of eastern Shasta, Lassen and Modoc Counties from the early days of the wagon to our present-day high speed automobiles and trucks. The trip from Redding to Burney by wagon was a major undertaking requiring from four to six days. Along the way were stopovers where horses were changed and meals could be obtained. Freight wagons hauling over the hill from Montgomery Creek to Burney usually made the trip in two days, stopping over night at Fuller's on Little Hatchet Creek. Now the trip from Redding to Burney takes about two hours and as one passes through the hills the thought comes to mind, "how did the old-timers do it?"

Old-timers on Job

Construction on this section of U. S. 299 was started in 1918 and the Hatchet Creek work was completed in 1923 and 1924. Two of the original workers for the day labor construction, as done by the State in those days, are still working for the State. Ralph Hill is maintenance foreman on this section of road which he helped to construct, and another old-timer, L. E. Robinson of Millville, is maintenance foreman on the route to Lassen Park. There may be others still working for the State who had some part in the first building of a highway across Hatchet Mountain.

The writer first went over Hatchet in 1919 to work on a staking-out party for the day labor camp at Adin Summit where construction was going on under the guidance of Spencer Lowden, now district engineer of District VIII. In 1921 another trip on foot was made from Montgomery Creek to Burney when a party of 15 men started the survey from Burney to Fall River Mills.

Freeway Bids

Public Works Director Frank B. Durkee has authorized advertising for bids for construction of an experimental section of the Bayshore Freeway across the San Francisco Bay mud flats.

The project will consist of a dirt fill causeway to carry a 132-foot roadbed from the south city limits of San Francisco at Candlestick Point for a distance of six-tenths of a mile toward South San Francisco. It will end in the water, and will not be extended until results of the experiment have been analyzed.

Highway Engineer George McCoy said it will follow the planned line and design of that portion of the Bayshore Freeway, and will not be lost.

The purpose, he explained, is to determine whether underlying water and mud can be forced out by sheer weight, eliminating the necessity of employing a highly expensive system of pumping out mud and backfilling with a sand blanket. The 1951-52 highway budget provided $402,800 for the project.

Hand Labor Used

The original highway was constructed with the use of horse and mule-drawn equipment to move excavated material. All finishing and subgrading was done by hand. Drilling was done by single jack hand labor. To eliminate haul of any consequence, the road followed the contour of the hills. As the years progressed, maintenance forces widened the road from the original 16-foot section to a wider passable width of 20 feet of oil surface plus shoulders.

Today's construction was done by diesel tractors and 15- to 18-yard carryalls. Drilling was done by pneumatic jackhammers. Subgrading and finishing was accomplished with the use of No. 12 motor graders. Hand labor was used only for clearing and some final finishing. Culvert pipe was placed by hand.

The construction of this section of highway eliminates eight curves with 534 degrees of curvature and saves 82 feet of rise in grade. The small, narrow bridge designed and built by the county in 1923 was replaced by a standard arch culvert 16 feet wide with a 17-foot rise having a carrying capacity of 3,600 second-feet at flood. The culvert is 241 feet long and has a dissipating basin at the outlet to stem the flow.

Volcanic Ash Held Water

Some difficulty was encountered in the roadway excavation, as free water was found in the cuts which were made up of lava in decomposed form lying over a formation of mud around a layer of large boulders. The mud was a fine volcanic ash and held water to the extent of from 30 to 40 percent by weight. Therefor, no water was needed in the construction of the fills except for the top portion. At times construction equipment had difficulty in moving and had to be pushed and pulled by three extra tractors. Loaded

. . . Continued on page 55

Encouraging

California Highway Construction Cost Index Drops 6.9 Percent

By RICHARD H. WILSON, Assistant State Highway Engineer
H. C. McCARTY, Office Engineer
R. R. NORTON, Assistant Office Engineer

During the third quarter of this year a slight drop occurred in the California Construction Cost Index. The index for this third quarter decreased from 238.3 in the second quarter (1940 = 100) to 221.9, a drop of 6.9 percent.

The 15-month period from the first quarter of 1950 to the second quarter of 1951 ending on June 30, 1951, showed the most rapid increase in highway construction costs in California that has occurred since 1940, when the California Highway Construction Cost Index (1940 = 100) rose from 160.0 in the first quarter of 1950 to 238.3 in the second quarter of 1951, a rise of 48.9 percent.

The cost of state highway construction in California increased 22.3 percent in the first half of this year to reach the highest peak in highway construction costs in California.

Comparative Figures

The Engineering News Record Construction Cost Index showed a 1 percent increase from March to September, 1951, after a 10.2 percent rise in the preceding year. Cost figures in the Bureau of Public Roads Composite Mile Index for the third quarter of 1951 rose to 230.2, an increase of 5.8 percent during the first three quarters of the year, which compares to a rise of 13.9 percent in the California index for the same period.

With the continued increase in living costs, higher income and other taxes, and with the increasingly short supply of steel and other essential materials and the attendant uncertainties, delays, and higher costs, we cannot feel

**CALIFORNIA DIVISION OF HIGHWAYS
AVERAGE CONTRACT PRICES**

	Roadway excavation, per cu. yd.	Crusher run base, per ton	Plant mix surfacing, per ton	Asphalt concrete pavement, per ton	PCC pavement, per cu. yd.	PCC structures, per cu. yd.	Bar reinforcing steel, per lb.	Structural steel, per lb.	
1940	$0.22	$1.54	$2.19	$2.97	$7.68	$18.33	$0.040	$0.083	All projects
1941	0.26	2.31	2.84	3.18	7.54	23.31	0.053	0.107	
1942	0.35	2.81	4.02	4.16	9.62	29.48	0.073	0.103	
1943	0.42	2.26	3.71	4.76	11.48	31.76	0.059	0.080	
1944	0.50	2.45	4.10	4.50	10.46	31.99	0.054	0.132	
1945	0.51	2.42	4.20	4.88	10.90	37.20	0.059	0.102	
1st Half, 1946	0.41	2.31	4.00	4.54	9.85	37.38	0.060	0.099	Federal aid projects only
2d Half, 1946	0.39	2.27	4.12	5.04	12.39	49.84	0.079	0.142	
1st Half, 1947	0.48	2.62	4.52	6.46	12.41	47.03	0.080	0.133	
2d Half, 1947	0.54	2.39	4.02	6.48	11.58	50.15	0.089	0.123	All projects
1st Half, 1948	0.56	2.45	4.42	4.91	13.37	49.51	0.094	0.145	
2d Half, 1948	0.52	2.64	4.80	7.00	14.01	49.08	0.103	0.131	
1st Quarter, 1949	0.49	2.48	4.54	5.70	11.84	48.11	0.089	0.113	
2d Quarter, 1949	0.43	2.91	4.63	4.06	11.74	48.63	0.083	0.110	
3d Quarter, 1949	0.41	2.40	5.05	4.60	11.53	45.35	0.080	0.093	
4th Quarter, 1949	0.43	2.55	3.78	3.50	12.66	44.54	0.078	0.092	
1st Quarter, 1950	0.34	2.22	3.65	3.74		40.15	0.077	0.081	
2d Quarter, 1950	0.40	2.13	4.48	3.74	10.86	43.03	0.080	0.105	
3d Quarter, 1950	0.41	2.32	4.25	5.50	10.91	44.34	0.093	0.131	
4th Quarter, 1950	0.42	2.81	4.64	4.61	12.55	43.18	0.098	0.120	
1st Quarter, 1951	0.45	3.07	4.06	5.22	11.71	46.38	0.103	0.206	
2d Quarter, 1951	0.63	3.88	4.56	4.63	12.93	51.50	0.105	0.166	
3d Quarter 1951	0.56	2.88	4.59	3.90	12.41	46.14	0.107	0.165	

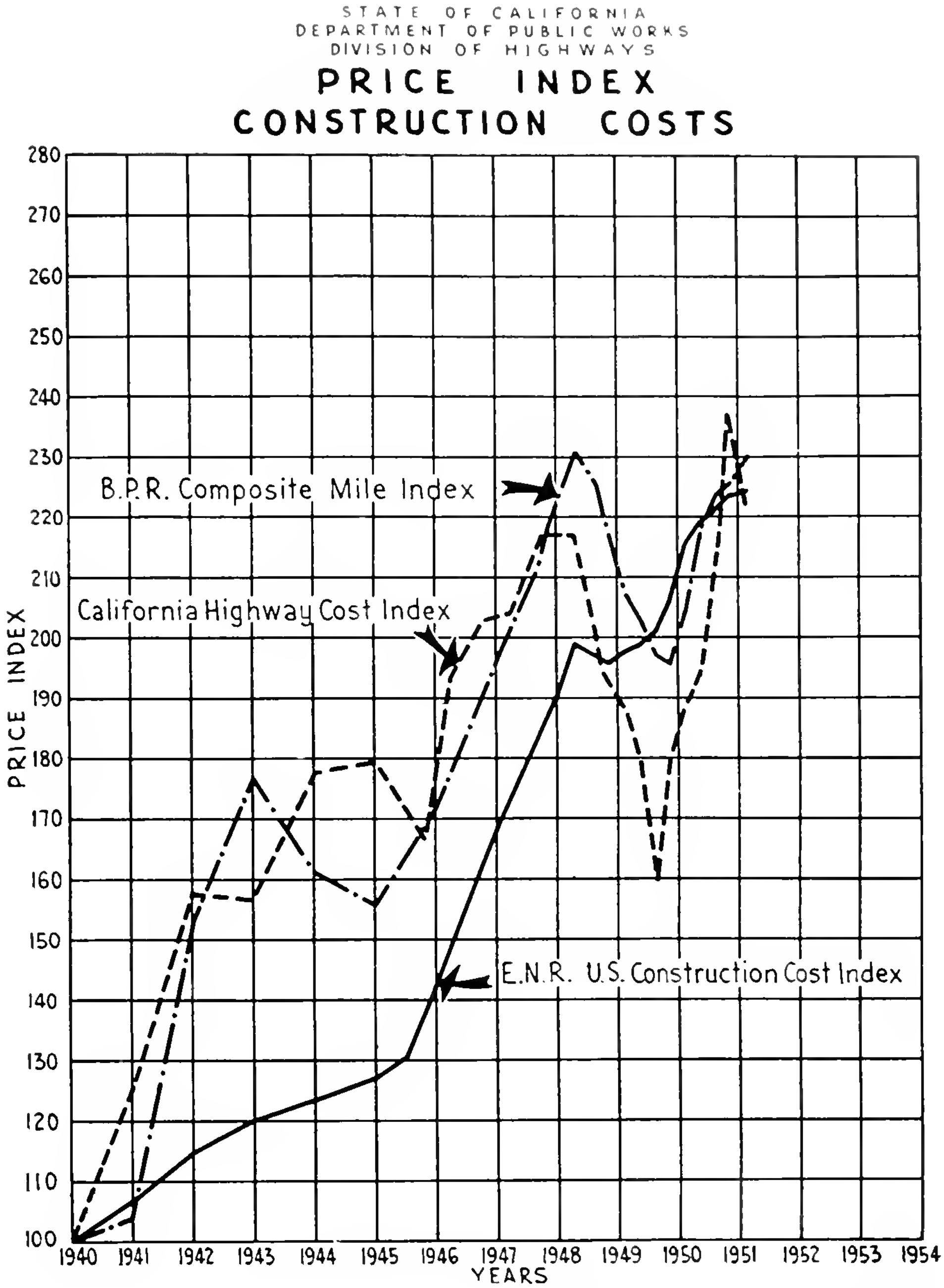
there is much possibility of any continued drop in the cost of highway construction. The sharp rise of the California index over that of the Engineering News Record Construction Cost Index and the Bureau of Public Roads Composite Mile Index in the second quarter of 1951 was undoubtedly a local condition in California occasioned by an upsurge of federal construction projects released in May and June in order to take up available funds before the end of the fiscal year. If such was the case, the 6.9 percent drop in the California index for the third quarter is merely a temporary drop from a false peak in the general upward trend of prices.

Outside Factors

From the highway viewpoint, consideration must be given to outside factors, such as more stringent control of materials, increased tax levels, and the anticipated competition from the recently voted $5,864,000,000 in expenditures ($467,000,000 in California alone) for construction projects for the Air Force, the Army, and the Navy, which may adversely affect bids for highway construction costs and raise them to higher levels. From consideration of the current trend and these outside factors it is our opinion that a continued rise in the California Construction Cost Index may be expected during the fourth quarter of 1951.

Following is a tabulation of the California Highway Construction Cost Index since the first postwar peak was reached in the first half of 1948:

Period	Index 1940 = 100	Change from previous period	Change from 1st half 1948	Change from 1st qtr. 1950
1948 (1st half)	216.8			
1948 (2d half)	216.4	—0.2%	—0.2%	
1949 (1st qtr.)	200.4	—7.3%	—7.6%	
1949 (2d qtr.)	195.7	—2.3%	—9.7%	
1949 (3d qtr.)	187.9	—4.0%	—13.3%	
1949 (4th qtr.)	178.8	—4.8%	—17.5%	
1950 (1st qtr.)	160.0	—10.5%	—26.2%	
1950 (2d qtr.)	180.0	+12.5%	—17.0%	+12.5%
1950 (3d qtr.)	189.2	+5.1%	—12.7%	+18.3%
1950 (4th qtr.)	194.8	+3.0%	—10.1%	+21.8%
1951 (1st qtr.)	215.4	+10.6%	—0.6%	+34.6%
1951 (2d qtr.)	238.3	+10.6%	+9.9%	+48.9%
1951 (3d qtr.)	221.9	—6.9%	+2.4%	+38.7%



Highway Costs

Highway costs as measured by the California Highway Construction Cost Index with the year 1940 taken as a base of 100, climbed during World War II and the postwar period to a peak of 216.8 in the first half of 1948. After 1948 there was a decline to 160.0 in the first quarter of 1950. From this point on, there was a very rapid rise through the second quarter of 1951. The second quarter of 1950 was 12.5 percent above the first quarter of 1950; the third quarter was 5.1 percent above the second quarter; the fourth quarter was 3.0 percent above the third quarter; the first quarter of 1951 was 10.6 percent above the fourth quarter of 1950, and the index reached 238.3 in the second quarter of 1951 which was 10.6 percent above the first quarter. The index for the third quarter of 1951 decreased 6.9 percent from the second quarter of 1951 to 221.9, the first drop since the first quarter of 1950, which is considered merely the leveling-off of a false peak to the general line of the continued rise.

Plumb Bob Points

Their Standardization Is Important to All Engineers

By G. G. McGINNESS, Assistant Engineer, Service and Supply

If each manufacturer of household light globes designed the screw base according to their own individual fancy, you couldn't go to the corner grocery and ask for just a "light globe" and have it fit the socket in your lighting fixture. You would have to remember that your fixtures take General Electric globes, Westinghouse globes or one of a dozen others. If you had forgotten, you would have to climb on a chair or stepladder and attempt to find some identification so you would know what lamp to ask for and be sure that it would fit properly in the socket. We can be thankful that lamp manufacturers standardized when they began making electric light globes. We can buy light globes without any concern about the base fitting the fixture. Surveyors, construction men and mechanics who use precision plumb bobs haven't been so fortunate when they have needed to replace a plumb bob point.

Precision plumb bobs are made in sizes ranging from 4 to 96 ounces with those from 10 to 16 ounces being most common while those larger than 24 ounces are quite rare. It is estimated that American manufacturers produce several hundred thousand precision bobs each year. The California Division of Highways uses about 400 16-ounce precision plumb bobs each year and requires over 500 replacement points annually.

Every survey crew in America is equipped with one or more bobs

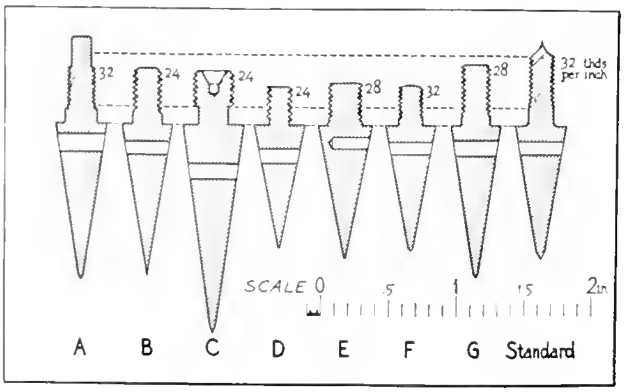
Chainman using plumb bob to transfer measurement from tape to point on ground

which are used to transfer a point on the ground to a point some distance above the ground or vice versa. A plumb bob is hung from a transit so that it may be centered over an exact point on the ground. Chainmen use them so points on the ground may be measured with a tape supported only at the ends.

In normal use, plumb bob points are worn out, damaged, broken, and occasionally lost, and for these reasons require replacement. The point of a bob is commonly used as a scribe to mark a point on rock or concrete and this causes rapid wear in addition to the wear in normal use.

Headache for Engineers

Most bobs are marked with the name of the manufacturer or distributor but, as the bobs are made of brass, these names are often obliterated. When a surveyor wants a replacement point and can't identify the make of bob, which is usually the case, he must send a sample or trust to luck. As he wants to continue using the bob and can't spare the point for a sample, he likely will trust to luck. Probably the supplier will have to write a letter requesting identification by catalog number. The surveyor is unable to supply this information so the supplier must send samples from which the surveyor can choose a point to fit his bob. Even when the name of the distributor of the bob is known, there is no assurance that the points ordered will fit the bob, as one distributor has been known to supply bobs with three different points within a period of 10 years. All this trouble and delay increases the supplier's overhead and wastes the time of the surveyor.



Various replacement points of common American precision plumb bobs. The cross sections, accurately scaled from points purchased in the market, give graphic comparison of details such as sharp corners, size and number of threads, abrupt thread terminations, etc.

Tentative Standard Proposed

A bob point must be accurate with all elements concentric with a straight axis and the threaded connection must hold the point concentric with the body of the bob. The point should also be readily replaceable without the use of any special tool and the threaded connection should be so machined that when normally installed,

it will be secure against loss. The material from which the point is made should be hard enough to resist wear and deformation and at the same time tough enough to resist breaking.

To overcome the difficulty in obtaining replacement points for bobs and to develop a point satisfactory to all concerned, a committee of civil and mechanical engineers, manufacturers and distributors was formed. This committee has submitted a tentative standard to the National Bureau of Standards. Many American manufacturers are already producing replacement points conforming to their specifications. The tentative standard form, which the committee believes will meet all of the requirements, is shown in the accompanying drawing.

Major Nominal Diameter

The major nominal diameter of three-eighths inch was adopted because at least 90 percent of all plumb bob points manufactured at present are of this size. This size offers adequate protection to the bob and may be turned from ordinary commercial three-eighth-inch bar stock within the tolerances allowed.

Nearly all high quality precision bobs follow a design which calls for a nominal 20 degrees included angle of cone. As the point taper should conform with the taper of the bob, this angle was chosen. The tolerance of one-half degree plus or minus allows a deviation of one degree and this accuracy can easily be maintained in manufacture.

The No. 40 drill hole is larger than generally used and will allow the use of more readily available pins or nails for removal or installation. The hole is drilled clear through as it is much easier to dig hardened mud from a clear hole than a blind hole.

Tips of Points Vary

The tips of bob points have varied a great deal according to the manufacturer. Some were needle points which easily became broken while others were very blunt and therefore lacked accuracy. The tip shown in the drawing was adopted after careful consideration of all factors.

The threaded connection is probably the most important part of the bob point and it is also the part which has varied the greatest in manufacture. It is this feature that has caused so much confusion and delay to surveyors and suppliers in obtaining replacements. The accompanying illustration shows seven common points and gives a good comparison with the tentative standard.

Plumb bob being used to center transit over survey point on ground

The 10-32 thread was chosen because it would impose the least hardship on both users and manufacturers. Many bobs have been made with this thread and have given satisfactory service for years. The several features were carefully considered to avoid concentration of stresses and facilitate manufacture. The preferred sharp cone-like termination is not required but will make it possible to test the point quickly by holding it lightly between the thumb and forefinger and spinning. If straight and concentric, it will rotate without vibration. The threaded hole in the bob will, of course, have to conform with the threaded connection on the point.

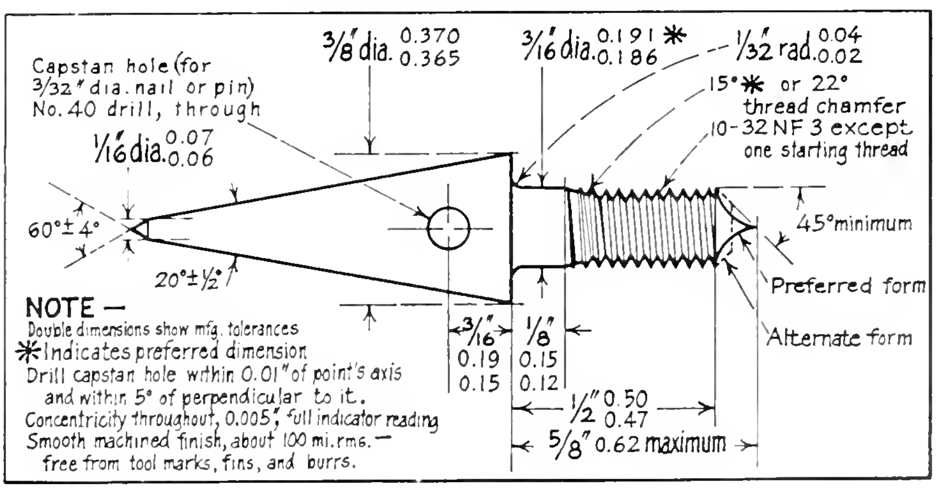
State Cooperates

As shown on the accompanying drawing, the point is to be finished smooth and free from tool marks. They may be plated with a suitable metal to make them rust-proof and when not so plated they should be coated with a wax-type rust inhibitor.

This tentative standard concerns itself with only the form of the bob point and does not presume to specify the type of material to be used. The Service and Supply Department of the California Division of Highways has cooperated with the Standardization Committee and has for some time specified that bobs furnished to the Divi-

. . . Continued on page 57

American Standard Point for precision plumb bobs.



Another Unit of Coast Highway Freeway Is Under Way

Contemplated four-lane divided expressway is being made apparent by construction now in progress on the Coast Highway, U. S. 101, in Santa Barbara County between one-half mile east of Arroyo Parida and Ortega Hill at Summerland.

This is the second of three units which will extend the initial expressway on the Coast Highway known as the Montecito Parkway, 9.7 miles to the Santa Barbara-Ventura County line.

Heavy equipment engaged in construction at Summerland

Construction of the first unit of this project from the Ventura County line to Carpinteria, a length of 2.5 miles, was completed in October, 1950, at a cost of $690,000.

The current contract was awarded to the Griffith Construction Company of Los Angeles on August 10, 1951. This contract includes the construction of three reinforced concrete flat-slab type bridges and a reinforced concrete pedestrian undercrossing, grading roadbeds for a four-lane divided highway together with frontage roads, and paving with Portland cement concrete on cement treated subgrade and with plant-mixed surfacing on cement treated base. The amount of the contract for constructing this 3.7 miles of freeway is $1,135,000. Its completion is scheduled for the fall of 1952.

Preparation of plans is now in progress for the third unit from Carpinteria to one-half mile east of Arroyo Parida and from Ortega Hill to Sheffield Drive, a net length of 3.5 miles. Funds for acquisition of the rights of way on this unit have been programed for the 1952-53 Fiscal Year. Subsequent construction will have to wait until additional funds can be budgeted.

The existing roadway will serve as the southbound lanes of the expressway with new lanes being constructed for northbound traffic, except through the towns of Carpinteria and Summerland. The expressway will be along new alignment to the north of the existing highway. Construction now in progress through Summerland is along the location between the present highway and the main coast line of the Southern Pacific Railroad Company, which borders on the Pacific Ocean. The present highway will become the outer highway serving the business section fronting on it and the adjacent residential area.

A pedestrian undercrossing is being constructed at Hollister Street to provide a crossing of the expressway for the pedestrian traffic between the town and the adjacent beach. This beach area, which was the site of one of California's early oil fields, is being rehabilitated and developed as a recreational area by the County of Santa Barbara.

Hatchet Mountain

Continued from page 49 . . .

carryalls in one of the cuts had to be pushed downhill for the greater portion of the excavation of that cut.

The pictures show the improvement over the years in highways over Hatchet Mountain and the bridge that was eliminated by the present project.

The work was done under contract by Eaton & Smith of San Francisco for the Division of Highways, District II, J. W. Trask, District Engineer. The author was resident engineer under the supervision of H. Clyde Amesbury, District Construction Engineer.

Construction on Hatchet Mountain section of U. S. 299

AASHO Defines Aims In Resolutions

In accordance with past practice, *California Highways and Public Works* publishes the resolutions adopted at the annual meeting of the American Association of State Highway Officials which was held this year in Omaha, Nebraska, October 23-26.

The resolutions:

RESOLUTION NO. 1

Allocation of Critical Materials for Highways

WHEREAS, The members of the American Association of State Highway Officials realize their responsibility to national defense, civil defense, and the over-all welfare and national economy, and therefore feel that preservation of an adequate highway system is imperative; and

WHEREAS, Due to the prewar depression and the World War II restrictions on highway construction, the highway facilities have been found to be seriously depleted and continuous rehabilitation and reconstruction is essential if the Nation is to maintain an economy to support the national defense effort; and

WHEREAS, The states in cooperation with the Bureau of Public Roads have determined their needs and are the recognized authority on such needs; and

WHEREAS, The deficiency of the highway plant which provides service for over 50,000,000 motor vehicles has been materially aggravated by unusually severe curtailment of critical materials, principally steel products, almost to the point of paralyzing this essential system; therefore, be it

Resolved, by the American Association of State Highway Officials, in annual meeting assembled in Omaha, Nebraska, October 23-26, 1951, that: (1) the essentiality of highways be given proper recognition by increasing the allotment of steel for highway purposes to at least 2 percent of the total national production to meet the demands of vital traffic upon the highways of the Nation; (2) that this association voices complete confidence and satisfaction in the work of the Bureau of Public Roads as claimant agency, and requests that this bureau continue to function in that capacity notwithstanding the untenable conditions which have resulted from the curtailment of allotment of critical materials; and (3) since highway equipment is now being classified in a low position of priority in relation to other equipment, it is urged that the classification of such equipment be raised to its proper relationship of importance for maintaining the national defense and national economy; and be it further

Resolved, That the recommendation of Thomas H. MacDonald, Commissioner of the Bureau of Public Roads of the United States, that highways be reclassified as an industrial facility which is recorded on page 113 in the Report of Hearings, September 6 and 7, 1951, before a subcommittee of the Committee on Public Works of the United States Senate, entitled "Steel Allocation for Highways" is hereby endorsed and supported; and be it further

Resolved, That the public be advised why necessary critical materials are not forthcoming for carrying on this essential rehabilitation of our highway systems in the interest of national defense, and in view of the fact that an appropriate resolution has already been introduced into the Congress on the subject of adequate critical materials for highways, it is suggested that the Congress of the United States, through whatever channels it may deem appropriate, explore the situation to the end that a satisfactory result may be forthcoming.

STATE HIGHWAY ENGINEER McCOY HONORED BY AASHO

State Highway Engineer George T. McCoy returned from the annual convention of the American Association of State Highway Officials held this year in Omaha with a new engineering honor.

McCoy was elected a member of the executive committee of the AASHO to succeed the late Charles H. Purcell, who died suddenly last September 7th. Mr. Purcell had been a member of the executive committee for 21 years. He retired as California Director of Public Works on July 31, 1951.

When Purcell was appointed by Governor Warren to be Director of Public Works in January, 1943, McCoy succeeded him as State Highway Engineer.

RESOLUTION NO. 2

Resolution opposing the granting of authority to common carriers for the hauling of explosives over the public highways.

WHEREAS, There is pending before the Interstate Commerce Commission of the United States applications of more than 50 trucking companies which now engage in transporting various commodities and which now seek authority to engage in the business of transporting dangerous explosives, ammunition, and component parts thereof over the highways of the several states; and

WHEREAS, Before authority may be granted the Interstate Commerce Commission must decide from the evidence that the public convenience and necessity requires the proposed operation and that the transportation of explosives is in the public interest and would not endanger the public safety; and

WHEREAS, Extreme hazard is inherent in the handling and transporting of dangerous explosives under any circumstances and could endanger irreplaceable highway facilities such as major bridges and vehicle tunnels; and

WHEREAS, The states and their political subdivisions are responsible for the safety of the public in the use of highway facilities; and

WHEREAS, The injection of increased quantities of dangerous explosives into the stream of traffic on our already congested streets and highways, far too many of which are

deteriorated and obsolete, could conceivably accelerate the mounting total of traffic accidents; and

WHEREAS, The national welfare may require under some circumstances the movement of dangerous explosives over the public highways, all available facts should be carefully weighed to assure that the need to be met is commensurate with the risk involved; therefore, be it

Resolved, that the American Association of State Highway Officials, assembled in annual meeting at Omaha, Nebraska, October 23-26, 1951, Recognizing the highway departments' responsibilities for furnishing efficient highway facilities for the Nation's civilian and defense needs, and the further responsibility of safeguarding these vital facilities from accidental damage or destruction, does vigorously oppose the granting of continuing authority requested in the pending applications of the trucking companies to transport dangerous explosives, ammunition, and component parts thereof promiscuously over the streets and highways of the several states.

RESOLUTION NO. 3

Impact of Water Resources

WHEREAS, The President's Water Resources Policy Commission has recommended that federal and state water resources and highway development agencies should coordinate their efforts from the earliest stages of water project planning; and

WHEREAS, It appears that such coordination of effort is in the public interest and already has been started; and

WHEREAS, It appears that such coordination cannot be continued effectively unless information is prepared to show the impact of such projects upon highway development; therefore, be it

Resolved, that the American Association of State Highway Officials, in annual meeting assembled in Omaha, Nebraska, October 23-26, 1951, acting through its committees and through the administrative actions of the respective highway authorities, Take the appropriate steps to further the coordination of water resources projects and highway development as the public interest requires; and be it further

Resolved, That the association take such action as may be necessary in securing the enactment of legislation authorizing and directing the preparation and evaluation, on a nation-wide basis, of information showing the impact of water resources projects upon highway transportation and development, including data relating to the over-all effect of (1) horizontal and vertical navigation clearance requirements for highway bridges, (2) dam and reservoir construction, and (3) withdrawal of public lands for future power development.

RESOLUTION NO. 4

Scrap Drive

WHEREAS, The Undersecretary of Commerce for Transportation and the Commissioner of the Bureau of Public Roads, in addressing the annual meeting of the American Association of State Highway Officials, stated that the need for ferrous and nonferrous scrap materials may affect defense production; therefore, be it

Resolved, that the American Association of State Highway Officials, in annual meeting assembled in Omaha, Nebraska, October 23-26, Take the following action through the several member departments: that an immediate survey be undertaken by all state, county, and city highway departments to estimate the approximate tonnage of ferrous and nonferrous scrap available within the departmental operations and to encourage the flow of dormant scrap into processing channels and report this activity to the Bureau of Public Roads.

RESOLUTION NO. 5

In Appreciation of the Services of President J. A. Anderson

In appreciation of the many years of outstanding service rendered to this association in serving on various committees of the association, and as a member of the executive committee, as vice president, and as president for the past year, during which time he has guided the association by his sound judgment, ability and dynamic energy; therefore, be it

Resolved, by the American Association of State Highway Officials in meeting assembled in Omaha, Nebraska, October 23-26, 1951, That this association hereby expresses its appreciation for a job magnificently done and extends its sincere thanks to him on the occasion of his retirement from the high office of president of the association.

RESOLUTION NO. 6

Appreciation and Thanks

WHEREAS, the thirty-seventh annual meeting of the American Association of State Highway Officials, held in Omaha, Nebraska, October 23-26, 1951, has been in all respects an outstanding success; and

WHEREAS, This success has sprung from the splendid hospitality and cooperation of the people of Nebraska who have spared no effort or service to make this a happy and profitable visit and meeting; therefore, be it

Resolved, that the American Association of State Highway Officials in meeting assembled in Omaha, Nebraska, October 23-26, 1951, Does hereby express its sincere thanks and appreciation for the warm welcome and the courtesies extended by His Excellency, Val Peterson, Governor of the great State of Nebraska, the Nebraska State Highway Department, the City of Omaha, the Omaha Chamber of Commerce, Boys Town, and all others who have contributed so unsparingly of their time and effort to make this meeting an outstanding success.

Plumb Bob Points

Continued from page 53 . . .

sion of Highways shall have points conforming to the tentative standards.

The Service and Supply Department intends to go further by preparing specifications for the whole plumb bob so that not only the form of the point is standardized but also the bob itself and the cap and all materials used in the manufacture. The specifications for the bob will probably be broad enough to include the form of practically all precision bobs now manufactured but the form of the cap and threaded end will be specified to close tolerances.

(The author is grateful to the American Congress of Surveying and Mapping for their permission to use portions of the article "A Standardized Point for Precision Plumb Bobs" which appeared in the January-March, 1950, issue of Surveying and Mapping.*)*

Traffic Engineering

Continued from page 10 . . .

An attempt is being made to find some method of correlating traffic volumes or turning movements with accident rates, and also to establish a sound warrant for separation of grades. Approximately 180 intersections are included in this study.

Another research project which is closely related to the first is a study of accidents and volumes at signalized intersections on all types of roads and streets. This involves the detailed study of operation of approximately 280 intersections.

Still another study under way covers the proper detector spacing for traffic-actuated signals on high speed expressways. This involves detailed observation and analysis of traffic behavior and delay at one intersection with detectors at several locations in advance of the actual intersection.

Past Achievements

During the past several years a number of traffic research projects have been undertaken and completed. Some of these were made for departmental use only, while others have been published and given wide circulation. An example of the latter type was a study of truck turns. In this study, made on an abandoned airport, maximum legal commercial vehicles were put through various maneuvers in order to measure the shape and width of the wheel paths, particularly on sharp turns. This truck path study apparently filled a long felt need, since requests have been received for it from all parts of the world. The information developed therein has been adopted by the division, and all new designs are now based thereon.

A study was made of all accidents on all divided highways in the State in order to determine the relation of type and width of median strips to accident rates.

. . . Continued on page 64

J. E. O'Neill Is Elected Head of AAA

J. E. O'NEILL

J. E. O'Neill of Fresno was elected president of the nation-wide American Automobile Association at the AAA annual meeting in Kansas City, Missouri, of which he is a director and past president.

O'Neill takes over the leadership of the AAA's 3,500,000 members in the United States and Canada, following years of civic service to the cause of motoring, traffic safety and highway development. He is active in civic affairs in the San Joaquin Valley where he has extensive cotton, cattle and agricultural interests. He is Vice President of the Producers Cotton Oil Company, one of the largest firms in the cotton business in California. He is also President of the Twenty-first Agricultural District which stages the Fresno District Fair and a director and past president of the California State Automobile Association.

Powdered Rubber

Continued from page 6 . . .

An inspection of the pavement made in February, 1951, and again in August, 1951, showed no apparent difference between the experimental section containing rubber and the rest of the job without the addition of rubber. (*See Figures 6, 7, 8, 9*). Undoubtedly, it will be some time before final conclusions can be drawn concerning the relative merits of the rubber-treated sections.

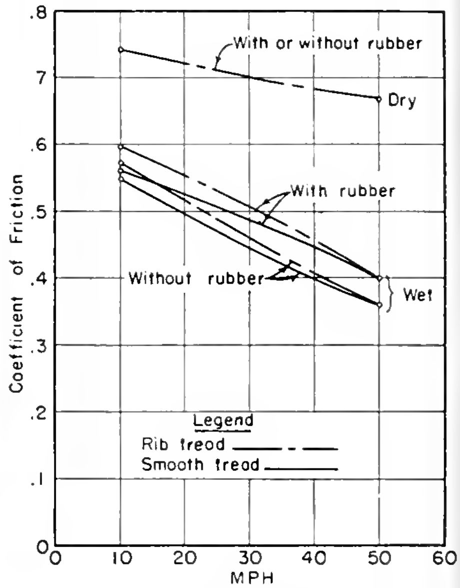


FIG. 13—Effect of rubber admixture on friction values of surfaces. April, 1951.

The construction of the experimental section was initiated by R. M. Gillis, Deputy State Highway Engineer, with the installation to be under the general direction of F. N. Hveem and T. E. Stanton of the Materials and Research Department. The project is located in Highway District III of which C. H. Whitmore is District Engineer. F. D. Hillebrand was Resident Engineer on the project and he and his assistants cooperated to the fullest extent. Fredrickson Bros. was the contractor. The writer was present as a laboratory representative during the placing of the experimental mixture.

MANNERLY DRIVING

Whenever there's a question of who has the right of way, let courtesy be your guide.

HIGHWAY BIDS AND AWARDS

October, 1951

ALAMEDA COUNTY—On Eastshore Freeway between Route 105 (Jackson Street) and Lewelling Boulevard, about 3.9 miles to be graded and paved with Portland cement concrete and plant mixed surfacing and highway separation structures to be constructed. District IV, Route 69, Section D, Hay., C. Erickson, Phillips & Weisberg, Gordon Ball and San Ramon Valley Land Co., Ball & Simpson, Berkeley, $2,760,098; United Concrete Pipe Corp., Baldwin Park, $2,957,531; Parish Bros., Benicia, $3,116,517; Guy F. Atkinson Co., South San Francisco, $3,152,593. Contract awarded to Fredrickson & Watson Construction Co. and M & K Corp., Oakland, $2,551,228.

ALAMEDA COUNTY—Pumping system at Folger Avenue underpass in Berkeley to be revised. District IV, Route 206. Martin Murphy, Walnut Creek, $9,849; McGuire & Hester, Oakland, $9,870; S & Q Construction Co., San Francisco, $10,858; J. Henry Harris, Berkeley, $12,594. Contract awarded to C. Norman Peterson, Berkeley, $8,264.

AMADOR AND CALAVERAS COUNTIES—Across Mokelumne River about four miles south of Jackson, a reinforced concrete box girder bridge to be constructed. District X, Route 65, Sections C, A. Erickson, Phillips & Weisberg, Oakland, $137,655; Charles MacClosky Co., San Francisco, $166,645; Lefever & Bing, West Sacramento, $174,015; Nomellini Construction Co., Stockton, $177,272; Thomas Construction Co., Fresno, $179,252. Contract awarded to Tumblin Company, Bakersfield, $132,905.

ALAMEDA COUNTY—Between the south city limits of Oakland and Alvarado Street, about 1.9 miles net length, a portion to be graded and surfaced with plant mixed surfacing on crusher run base and a portion to be widened with plantmixed surfacing on crushed rock base and resurfaced with plantmixed surfacing. District IV, Route 226. Independent Construction Co., Oakland, $204,874; Fredrickson & Watson Construction Co. and M & K Corp., Oakland, $211,477. Contract awarded to Lee J. Immel, San Pablo, $187,351.

CONTRA COSTA COUNTY—Between 3.5 miles south of Danville and Concord, portions about 3.6 miles in length, of roadway to be graded, subbase and base to be constructed and surfaced with plant mixed surfacing. District IV, Routes 107, 75, Sections A, WLC, B. Lee J. Immel, San Pablo, $352,570; Harms Bros., Sacramento, $379,584; J. Henry Harris, Berkeley, $385,851. Contract awarded to J. R. Armstrong, El Cerrito, $321,818.

FRESNO COUNTY—Between 5.8 miles south of Merced County line and 0.8 mile north of Mendota, portions extending over about 14.7 miles in gross length to be graded, surfaced with plant mixed surfacing on cement treated base, drainage structures to be extended or replaced, and existing bridge to be widened. District VI, Route 41, Sections M, N. Baun Construction Co., Fresno, $105,512. Volpa Brothers, Fresno, $109,409. Louis Biasotti & Son, Stockton; $110,924; M. J. Ruddy & Son, Modesto, $114,442. Contract awarded to Thomas Construction Co., Fresno, $103,662.

IMPERIAL COUNTY—Across New River at Seeley a steel stringer bridge to be constructed and approaches to be graded and surfaced. District XI, Route 12, Section C. R. M. Price Co., Altadena, $345,855; Norman I. Fadel, North Hollywood, $379,295; K. B. Nicholas, Ontario, $384,312. Contract awarded to R. P. Shea, Indio, $343,507.

LOS ANGELES COUNTY—On Harbor Freeway at 7th, 8th, and 9th Streets in the City of Los Angeles, six reinforced concrete box girder and slab bridges to be constructed and city streets to be graded and paved. District VII, Route 165. Charles MacClosky Co., San Francisco, $1,218,947; J. E. Haddock, Ltd., Pasadena, $1,227,409; Granite Construction Co., Watsonville, $1,231,091; Webb & White, Los Angeles, $1,236,402; MacDonald & Kruse and K. B. Nicholas, Sun Valley, $1,237,222; Bongiovanni Construction Co., Los Angeles $1,238,600; United Concrete Pipe Corp., Baldwin Park, $1,248,710; W. J. Disteli and R. J. Daum Construction Co., Los Angeles, $1,333,069; Winston Bros. Co., Monrovia, $1,396,741. Contract awarded to Oberg Bros. Construction Co., Inglewood, $1,160,099.

LOS ANGELES COUNTY—On Hawthorne Avenue between 174th Street and 137th Street, about 2.5 miles, to be graded and surfaced with plant mixed surfacing. District VII, Route 164. Vido Kovacevich Co., South Gate, $533,281; M. S. Mecham & Sons, South Gate, $535,968; Arthur A. Johnson, Laguna Beach, $553,045; Griffith Co., Los Angeles, $597,637; J. A. Thompson & Son, Inglewood, $598,253; J. L. Haddock, Ltd., Pasadena, $604,825; Tomei Construction Co., Van Nuys, $609,302; Boddum & Peterson, Long Beach, $609,940; Warren Southwest Inc., Torrance, $626,642; Dimmitt & Taylor, Monrovia, $653,915. Contract awarded to Oswald Bros. Co., Los Angeles, $526,731.

LOS ANGELES COUNTY—On Santa Ana Freeway, between Todd Avenue and Lakewood Boulevard, highway lighting, illuminated sign and traffic signal systems to be furnished and installed. District VII, Route 166, Section A. Westates Electrical Construction Co., Los Angeles, $118,986; Electric & Machinery Service Inc., South Gate, $119,720; C. D. Draucker Inc., Los Angeles, $121,654. Contract awarded to Fischbach & Moore Inc., Los Angeles, $114,464.

MARIPOSA COUNTY—Between 1.9 miles north of Mariposa and Acorn Inn, about 3.3 miles to be surfaced with plant mixed surfacing on untreated rock base and seal coats applied. District X, Route 18, Section D. Piombo Construction Co., San Francisco, $489,521. Contract awarded to Eaton & Smith, San Francisco, $454,886.

RIVERSIDE COUNTY—Between 10 and 36 miles west of Blythe, 19 timber bridges to be redecked with reinforced concrete slabs. District XI, Route 64, Sections C, D. Laredo Construction Co., Los Angeles, $68,100; E & J Corporation, Beverly Hills, $79,625; E. S. & N. S. Johnson, Fullerton, $79,731. Contract awarded to Norman I. Fadel, North Hollywood, $66,057.

RIVERSIDE COUNTY—At Cienega Rincon Creek, about 0.6 mile east of Aguanga, a reinforced concrete culvert to be constructed. District VIII, Route 78, Section A. E. L. Yeager Co., Riverside, $24,797; Laredo Construction Co., Los Angeles, $26,008; C. B. Tuttle Co., Long Beach, $26,024. Contract awarded to H. R. Breeden, Compton, $19,221.

RIVERSIDE COUNTY—Between Antelope Road and Route 64, about 10.5 miles to be graded, imported base material to be placed and a portion to be cement treated and surfaced with plant mixed surfacing. District VIII, Route 78, Section C. George Herz & Co. and C. G. Willis & Sons, Inc., Los Angeles, $839,925; A. Teichert & Son, Inc., Sacramento, $1,097,393. Contract awarded to E. L. Yeager Co., Riverside, $729,505.

SAN BERNARDINO COUNTY—Between Barstow and Amboy, 48 timber trestle bridges to be redecked with reinforced concrete slabs, plank floors and plant mixed surfacing. District VIII, Route 58, Sections F, G, H. J. Norman I. Fadel, North Hollywood, $211,994; E. S. & N. S. Johnson, Fullerton, $215,022; K. B. Nicholas, Ontario, $216,194; Geo. Herz & Co., San Bernardino, $232,995; R. M. Price Co., Altadena, $277,989. Contract awarded to C. B. Tuttle Co., Long Beach, $192,881.

SAN BERNARDINO COUNTY—Between Barstow and Baker, 30 timber trestle bridges to be redecked with reinforced concrete slabs, plank floors and plant mixed surfacing. District VIII, Route 31, Sections G, H, J. K. Thomas Construction Co., Fresno, $127,053; E. S. & N. S. Johnson, Fullerton, $131,130; George Herz & Co., San Bernardino, $135,099; E. G. Perham, Los Angeles, $151,576. Contract awarded to Norman I. Fadel, North Hollywood, $125,311.

SAN JOAQUIN COUNTY—Across Paradise Cut Overflow, about 6.7 miles east of Tracy, a reinforced concrete slab bridge to be constructed and approaches to be graded and paved with Portland cement concrete on untreated rock base. District X, Route 5, Section B. Erickson, Phillips & Weisberg, Oakland, $181,644; John Delphia, Patterson, $187,269; H. W. Ruby, Sacramento, $191,259; Dan Caputo, San Jose, $196,547; Charles MacClosky Co., San Francisco, $198,744. Contract awarded to Nomellini Construction Co., Stockton, $178,089.

SAN JOAQUIN COUNTY—At three locations between 1.3 miles east of Manteca and 4.5 miles east of Manteca, an existing reinforced concrete bridge to be widened, two reinforced concrete pipe siphons to be installed, and about 0.2 mile of roadway to be graded and surfaced with plant mixed surfacing on untreated rock base. District X, Route 66, Section B. Thomas Construction Co., Fresno, $31,866; M. J. B. Construction Co., Stockton, $38,303; Lefever & Bing, West Sacramento, $44,852. Contract awarded to M. J. Ruddy & Son, Modesto, $28,481.

SAN JOAQUIN COUNTY—Installing illumination fixtures at District X Office annexes. R. Goold & Son, Stockton, $3,075; Ets Hokin & Galvan, Stockton, $3,493; Curtis Electric Co., Stockton, $3,733. Contract awarded to Grider Electric Co., Stockton, $2,750.

SAN LUIS OBISPO COUNTY—Across Los Berros Creek, about 2 miles southwest of Arroyo Grande, a reinforced concrete slab bridge to be constructed and about 0.1 mile of approaches to be graded, surfaced with plant mixed surfacing on imported base material and seal coats applied. District V, Route 56, Section E. Thomas Construction Co., Fresno, $50,418; Madonna Construction Co., San Luis Obispo, $52,400; Laredo Construction Co., Los Angeles, $53,216; Ted Schwartz, Grass Valley, $53,985; Valley Paving & Construction Co., Inc., Pismo Beach, $55,686; Granite Construction Co., Watsonville, $59,397. Contract awarded to B. S. McElderry, Berkeley, $48,805.

SOLANO COUNTY—At the west and east entrances to Vacaville, at Davis Street, and at the Mason Street overhead, highway lighting systems to be furnished and installed. District X, Route 7, Sections C, Vac, D. Hall Sloat Electric Co., Inc., Oakland, $14,776; R. Goold & Son, Stockton, $15,880; Howard Electric Co., Gilroy, $19,865. Contract awarded to L. H. Leonardi Electric Construction Co., San Rafael, $13,990.

STANISLAUS COUNTY—Between the north city limits of Turlock and 0.6 mile northwesterly, about 0.6 mile, widening existing roadbed, constructing untreated rock base, placing plant mixed surfacing, and constructing pumping plant. District X, Route 4, Section A. Baun Construction Co., Fresno, $152,747; M. J. Ruddy & Son, Modesto, $167,374. Contract awarded to United Concrete Pipe Corp., Baldwin Park, $145,913.

STANISLAUS COUNTY—In Turlock State Park, about 8 miles west of La Grange, about 1.7 miles in net length, roads to be graded and penetration treatment applied. District X. Oilfields Trucking Co. and Phoenix Construction Co. Inc., Bakersfield, $19,319; Louis Biasotti & Son, Stockton, $29,805; R. C. Downer, Reno, $30,082; Lefever & Bing, West Sacramento, $31,475; M. Ritchie, Fresno, $39,064; J. Henry Harris, Berkeley, $53,816. Contract awarded to M. J. Ruddy & Son, Modesto, $15,659.

TUOLUMNE COUNTY—In Columbia State Park, parking area and service road to be graded, surfaced with imported base material and bituminous surface treatment and seal coat applied. District X. R. E. Maxwell, Jr., Sonora, $19,697; Beerman & Jones, Sonora, $21,744; Lefever & Bing, West Sacramento, $22,090. Contract awarded to Geo. E. France, Inc., Visalia, $15,385.

YOLO COUNTY—On West Sacramento Freeway, between Yolo Causeway and 0.8 mile west of Tower Bridge, about 3.3 miles of roadbed for a four lane divided highway to be graded. District III, Route 6, Section C. A. Teichert & Son, Inc., Sacramento, $647,096; M. J. B. Construction Co., Stockton, $673,885; Brighton Sand & Gravel Co. and Parish Bros., Sacramento, $690,972; Gordon Ball, San Ramon Valley Land Co. and Harms Bros., Berkeley, $706,876; H. Earl Parker, Inc., Marysville, $793,444; Fredrickson & Watson Construction Co., Oakland, $812,262. Contract awarded to United Concrete Pipe Corporation, Baldwin Park, $646,206.

F. A. S. County Routes

SOLANO COUNTY—On Broadway, between Nebraska Street and 1.2 miles north, to be graded and surfaced with plant-mixed surfacing on untreated rock base. District X, Route 1101. J. Henry Harris, Berkeley, $235,366; Parish Bros., Benicia, $235,330. Contract awarded to A. G. Raisch Co., San Rafael, $212,591.

November, 1951

FRESNO COUNTY—Between Selma and Fowler, about 3.6 miles of frontage roads with cross-overs and road connections to be graded and untreated rock base to be placed and surfaced with plant-mixed surfacing. District VI, Route 4, Section A. Paul E. Woof, Fresno, $111,513; Volpa Brothers, Fresno, $113,487; Griffith Company, Los Angeles, $123,861. Contract awarded to Bann Construction Company, Fresno, $101,048.

IMPERIAL COUNTY—Across Tesla Ditch, about 7.3 miles south of Riverside County line, a reinforced concrete slab bridge to be constructed. District XI, Route 26, Section E. Norman I. Fadel, North Hollywood, $24,046; Thomas Construction Co., Fresno, $24,234; J. E. Haddock, Ltd., Pasadena, $24,423; E. S. & N. S. Johnson, Fullerton, $25,933; C. B. Tuttle Co., Long Beach, $26,034; Walter H. Barber, La Mesa, $26,514; Byerts & Sons, Los Angeles, $28,610; E. L. Yeager Co., Riverside, $29,183; Webb & White, Los Angeles, $29,946; R. P. Shea Co., Indio, $33,801. Contract awarded to E. G. Perham, Los Angeles, $20,787.

KERN COUNTY—Between 0.5 mile south of Isabella and three miles west of Weldon, about eight miles to be graded and surfaced with imported base material with the upper portion bituminous surface treated. District VI, Route 57 Section I. Dimmitt and Taylor, Monrovia, $796,214; Richter Bros., Oroville, $808,826; A. Teichert & Son, Inc., Sacramento, $837,749; Eaton & Smith, San Francisco, $843,003; United Concrete Pipe Corp., Baldwin Park, $844,419; Fredrickson & Watson Construction Co., Oakland, $868,868; Ralph A. Bell Monrovia, $886,482. Contract awarded to Ball & Simpson, Berkeley, $762,411.45.

LOS ANGELES COUNTY—Over Ramona Freeway and Pacific Electric Railway tracks, at Campbell Avenue in the City of Alhambra, a structural steel and reinforced concrete bridge for pedestrian overcrossing to be constructed. District VII, Route 26. E & J Corp., Beverly Hills, $79,670; W. J. Disteli, Los Angeles, $81,121; J. E. Haddock, Ltd., Pasadena, $86,145; K. B. Nicholas, Ontario, $88,600; Gardner & McCall, Long Beach, $89,169; N. M. Saliba Co., Los Angeles, $94,476; O. B. Pierson, Bellflower, $95,023; Byerts & Sons & Geo. K. Thatcher, Los Angeles, $98,772; E. S. & N. S. Johnson, Fullerton, $99,691. Contract awarded to Griffith Co., Los Angeles, $74,923.

RIVERSIDE COUNTY — City of Corona, on Sixth Street at West Grand Boulevard and at East Grand Boulevard, traffic signal systems and highway lighting to be furnished and installed. District VIII, Route 43. Paul R. Gardner, Ontario, $9,810; Fischbach & Moore, Inc., Los Angeles, $11,787; Electric & Machinery Service, Inc., South Gate, $12,957; Westates Electrical Construction Co., Los Angeles, $13,248; C. D. Draucker, Inc., Los Angeles, $13,492. Contract awarded to Ed Seymour, Long Beach, $9,797.

RIVERSIDE COUNTY — At Alessandro Boulevard, traffic signal system and highway lighting to be furnished and installed. District VIII, Route 78, Section D. Paul R. Gardner, Ontario, $12,920; Electric & Machinery Service, Inc., South Gate, $13,504; Westates Electrical Construction Co., Los Angeles, $14,671. Contract awarded to Fischbach & Moore, Inc., Los Angeles, $12,872.

SACRAMENTO COUNTY—Under the tracks of the Southern Pacific Company on J Street and over J Street, in the City of Sacramento, an underpass and a bridge to be constructed and about one-fourth mile of city streets to be rough graded. District III. A. Teichert & Son, Inc., Sacramento, $354,169; United Concrete Pipe Corp., Baldwin Park, $366,709; John C. Gist, Sacramento, $394,729; George Pollock Co., Sacramento, $429,480. Contract awarded to Lord & Bishop, Sacramento, $349,825.50.

SACRAMENTO COUNTY—At Twin Oaks Avenue about 0.2 mile south of the Placer County line, for widening with plant-mixed surfacing on plant-mixed cement treated base. District III, Route 3, Section A. Contract awarded to McGillivray Construction Co., Sacramento, $16,653.90.

SANTA BARBARA COUNTY—At the west city limits of Lompoc, at Miguelito Channel, a reinforced concrete box culvert to be constructed, and a graded roadbed to be constructed and surfaced with plant-mixed surfacing. District V, Route 149, Section A. Owl Truck & Construction Co., Compton, $12,748; Valley Paving & Construction Co., Inc., Pismo Beach, $14,333; Madonna Construction Co., San Luis Obispo, $14,960; O. B. Pierson, Bellflower, $15,177; E. S. & N. S. Johnson, Fullerton, $16,700; Thomas Construction Co., Fresno, $16,840; B. S. McElderry, Berkeley, $21,325. Contract awarded to Laredon Construction Co., Los Angeles, $10,198.

SANTA BARBARA COUNTY—In Montecito, at the intersections of Coast Highway with San Ysidro Road (Eucalyptus Lane) and with Olive Mill Road, full traffic-actuated signal systems and highway lighting to be furnished and installed and channelization to be constructed. District V, Route 2, Section J. Electric and Machinery Service, Inc., South Gate, $35,174; Fischbach & Moore, Inc., Los Angeles, $35,686; Howard Electric Co., Gilroy, $36,373. Contract awarded to Westates Electrical Construction Co., Los Angeles, $34,174.25.

SOLANO COUNTY—One mile north of Cordelia Underpass, state-furnished truck-weighing scales to be installed, scale houses and truck height indicators to be constructed, electrical lighting and signal systems to be furnished and installed at two locations. District X, Route 7, Section B. Pike & Hill, Carey Bros. & Bailey, San Rafael, $22,656; Morrison Construction Co., Oakland, $26,397; Chittenden & Chittenden & Clemons, Auburn, $28,580. Contract awarded to Baldwin, Straub Corp., San Rafael, $21,902.50.

TEHAMA COUNTY—At various locations between Deer Creek Overflow and Mill Race Creek, 14 reinforced concrete bridges to be widened and about 0.3 mile of roadway to be widened and existing pavement to be resurfaced with plant-mixed surfacing. District II, Route 3, Sections A,D. O'Connor Bros., Red Bluff, $718,907; Fredrickson & Watson Construction Co., Oakland, $995,814. Contract awarded to Erickson, Phillips & Weisberg, Oakland, $548,512.

YOLO COUNTY—Between Washington Underpass and Tower Bridge about 0.6 mile of roadbed to be graded and drainage structures to be constructed. District III, Route 6, Section C. United Concrete Pipe Corp., Baldwin Park, $27,796; A. Teichert & Son, Inc., Sacramento, $38,960. Contract awarded to Brighton Sand & Gravel Co., Sacramento, $26,887.80.

F. A. S. County Routes

FRESNO AND MADERA COUNTIES—Across San Joaquin River at Friant, a reinforced concrete girder bridge supported on concrete framed bents to be constructed. District VI, Route 560. E. S. & N. S. Johnson, Fullerton, $85,842; Ted Schwartz, Grass Valley, $86,985; Lefever & Bing, West Sacramento, $92,429; Bos Construction Co., Oakland, $92,474; Trewhitt-Shields & Fisher, Fresno, $94,620; James H. McFarland, San Francisco, $107,556. Contract awarded to Thomas Construction Co., Fresno, $75,066.

SAN LUIS OBISPO COUNTY—On Calf Canyon-Huer Huero Road between 3.2 miles west of Huero Huero-La Panza Road and Creston-Highland Road, about three miles to be graded. District V, Route 676. Valley Paving & Construction Co., Inc., Pismo Beach, $87,863; M. J. B. Construction Co., Stockton, $91,133; Henry C. Dalessi, San Luis Obispo, $91,816; John Delphia, Patterson, $92,233; Gerald E. Brewster, Avenal, $92,954; Madonna Construction Co., San Luis Obispo, $98,390; Claude Fisher Co., Ltd., Los Angeles, $102,619; Esby C. Young, San Fernando, $106,085; Walter Bros. Construction Co., San Luis Obispo, $108,336; Oilfields Trucking Co. & Phoenix Construction Co., Inc., Bakerfield, $119,796; L. A. & R. S. Crow, El Monte, $141,305. Contract awarded to Louis Biasotti & Son, Stockton, $87,230.

YOLO COUNTY—Between County Road 27 and one mile north, four miles south of Woodland, about one mile of existing roadbed to be surfaced with plant-mixed surfacing on untreated rock base and penetration treatment applied to shoulders. District III, Route 1167. A. Teichert & Son, Inc., Sacramento, $36,405. Contract awarded to W. C. Railing, Woodland, $32,690.

Truck Noise

SHORT-SIGHTEDNESS on the part of business men a few years back, when highways were being routed, is largely to blame for today's clamor over truck noise in western cities.

Highway engineers, with better foresight than the merchants, wanted to by-pass small towns, route the arterial along back ways in the cities, but they were overwhelmed by political pressure applied by the business interests. Now these same business interests would seek to drive off part of the traffic that the engineers knew would be flowing over the route.

A state highway is an artery of commerce. If communities along the way, which had insisted that it be routed right down the main street, past the leading stores—because merchants foolishly thought the highway was going to bring a great flow of business—are permitted to impose restrictions on the use of the highways, then the state (and the merchants) will have lost a very valuable economic asset.—*Motor Transportation.*

NOW ON MAILING LIST

CITY OF LOS ANGELES
California

Department of Public Works
State of California
Sacramento, California

Sherman Oaks, Calif.

GENTLEMEN: I have seen copies of your publication *California Highways and Public Works* and have been so impressed with it I am writing to ask if I might be placed on your mailing list to receive copies in the future. I am certain the material contained in these publications will be of considerable value to me as a member of the Los Angeles City Planning Commission.

Sincerely yours,

EDMUND P. MCKANNA

SENSIBLE FOLLOWING

The distance you follow behind another vehicle is one indication of your competence in driving, says the California State Automobile Association. Never follow closer than a full car-length at very slow speeds. And when you're moving faster, always leave plenty of room between your car and the one in front of you, which may stop suddenly.

Well-placed Fencing

THE DIVISION OF HIGHWAYS of California is to be congratulated on what may be considered a minor matter in connection with construction of its vast network of freeways in Southern California.

In order to expedite the whole program with as little interference as possible with traffic flow, it has been found desirable in many cases to build isolated bridges first, and connect up the roadways later. In many cases, a hole is excavated just large enough for footings and abutments of the bridge, and when it is completed and traffic passes over the structure, only the rough edges of the excavation are visible.

But those edges and the dark recesses beneath the new bridge would be mighty attractive to exploring youngsters and prowling vandals. The State puts high wire mesh fences around each of these pits before they leave the site, in exactly the manner *Southwest Builder and Contractor* has long been urging for irrigation ditches, flood pools, and other man-made "attractive nuisances."

Thus the State protects its property from vandalism, denies the dark places to evil-doers, and protects children from dangerous falls and other accidents. The Division of Highways deserves a hand.—*Southwest Builder and Contractor.*

Budget Review

Continued from page 20 . . .

tive of one other point in his appeal, where he asserts:

> "It is fatuous to presume that we can do anything worth while by sporadic appearances before the State Highway Commission, demanding funds for 'our' special strip of highway."

What augurs well for the future of the California highway program is not so much this increasing public awareness of the relationship between highway safety and highway funds, but the state-wide point of view which it represents. The essential problem in a democracy is, as it always has been, to awaken and maintain intelligent public interest in governmental affairs.

Harvey D. Stover Retires After 34 Years

HARVEY D. STOVER—1951

HARVEY D. STOVER—1918

HARVEY D. STOVER, Senior Bridge Engineer with the Division of Highways, has retired after 34 years of state service.

Mr. Stover, who is widely known throughout the Division of Highways, was one of the early employees of the Bridge Department, having worked under Bridge Engineers H. E. Warrington, Harlan D. Miller, C. E. Andrews, F. W. Panhorst, and I. O. Jahlstrom.

The annual buck stew dinner which has by now become a tradition is due in great measure to the unfailing marksmanship of Harvey Stover, who year after year, has supplied the buck.

Harvey, who was born in a log cabin in Grant County, Indiana, December 12, 1886, started his bridge career at an early age. Shortly after graduation from high school, he went to work for D. L. Horner, an early day builder of concrete bridges in Indiana. In 1909, young Harvey came west to Berkeley, California, where he worked for several years on subdivisions in the Mt. Diablo regions of Contra Costa County, before entering the University of California. Graduating in 1915 with a B.S. degree in civil engineering, he spent one year with the City of Los Angeles Water Department and two years with the California Insurance Inspection Rating Bureau in charge of the Sacramento area.

In January, 1918, Harvey entered state service as a draftsman in the Division of Highways in District III. After taking time out for military service during World War I, Harvey returned to District III and two years later was transferred to the Bridge Department. In 1926, he became Bridge Design Engineer, a post he continued to hold for a period of 12 years. During this time, he was responsible for the design of some 1,200 bridges. These include all bridges on the Feather River Highway, Sacramento River Canyon route from Redding to the Oregon line, the Tower Bridge at the west approach to Sacramento, the coast highway from San Luis Obispo to Carmel, and numerous grade separation structures.

In 1938, Mr. Stover took over the duties of Bridge Maintenance and Research Engineer. This afforded him the

. . . Continued on page 63

Traffic Count

Figures for 1951 Show an Increase of 6.3 Percent Over 1950

By G. T. McCOY, State Highway Engineer

The annual state-wide traffic count taken on Sunday and Monday, July 15th and 16th, 1951, shows an increase of 6.3 percent over the immediately preceding annual count of 1950. Continuing the trend shown by the 1950 count, freight vehicles are again increasing at a slightly faster rate than passenger vehicles. Although all route groups show gains in traffic for both Sunday and Monday counts, the interstate connections show far greater increases than do any other route group. Sunday traffic shows greater gains than Monday traffic for all route groups, but the added week-end travel appears largely confined to the major routes since the recreational routes show the smallest gains.

No change was made from the regular procedure of previous years in the manner of taking the count. Actual recording covers the 16-hour period from 6 a.m. to 10 p.m. for both Sunday and Monday, totals being shown for each hour. At selected representative stations, counts are also continued for the entire 24-hour period and are extended to record each of the seven days of the week. Traffic is segregated into the following vehicle classifications: California passenger cars, out-of-state passenger cars, busses, pickups, two-axle commercial units, three-axle units, four-axle units, five-axle units, and six-or-more-axle units.

Each year some minor changes in the census become necessary, such as the relocation, addition, or discontinuance of individual stations; but in every instance these are excluded in determining comparison with the previous year, only those stations that were identical during both years being taken into consideration.

These comparisons for the various route groups are as follows:

PERCENT GAIN OR LOSS FOR 1951 COUNT AS COMPARED WITH 1950

	Sunday	Monday
All routes	+ 7.01	+ 6.21
Main north and south routes	+ 6.96	+ 6.25
Interstate connections	+13.39	+13.10
Laterals between inland and coast	+ 6.40	+ 5.53
Recreational routes	+ 5.30	+ 4.43

BASIS FOR SUMMARY

The gain or loss of traffic volume for State Highway Routes 1 to 80, inclusive, which constitute the basis for the foregoing summary, is shown in the following tabulation:

Route	Termini	1951 Percent gain or loss: Sunday Gain	Sunday Loss	Monday Gain	Monday Loss
1.	Sausalito-Oregon Line	3.46		5.53	
2.	Mexico Line-San Francisco	3.37		5.33	
3.	Sacramento-Oregon Line	11.70		5.83	
4.	Los Angeles-Sacramento	12.79		5.64	
5.	Santa Cruz-Junction Route 65 near Mokelumne Hill	5.80		6.42	
6.	Napa-Sacramento via Winters	7.34		3.57	
7.	Crockett-Red Bluff	10.66		12.10	
8.	Ignacio-Cordelia via Napa	10.27		9.20	
9.	Route 2 near Montalvo-San Bernardino	2.71		1.17	
10.	Route 2 at San Lucas-Sequoia National Park	2.57			2.87
11.	Route 75 near Antioch-Nevada Line via Placerville	12.22		14.80	
12.	San Diego-El Centro	11.74		15.16	
13.	Route 4 at Salida-Route 23 at Sonora Junction	9.93		8.24	
14.	Albany-Martinez	3.54		7.31	
15.	Route 1 near Calpella-Route 37 near Cisco	14.29		1.29	
16.	Hopland-Lakeport		0.97		7.49
17.	Route 3 at Roseville-Route 15, Nevada City	0.24		0.63	
18.	Route 4 at Merced-Yosemite National Park	9.83		5.45	
19.	Route 2 at Fullerton-Route 26 at Beaumont	6.25		7.28	
20.	Route 1 near Arcata-Route 83 at Park Boundary	6.52		9.20	
21.	Route 3 near Richvale-Route 29 near Chilcoot via Quincy	2.48		0.75	
22.	Route 56, Castroville-Route 32 via Hollister	2.04			2.25
23.	Route 4 at Tunnel Station-Route 11, Alpine Junction	18.27		13.33	
24.	Route 4 near Lodi-Nevada State Line	18.96			4.28
25.	Route 37 at Colfax-Route 83 near Sattley		6.25	5.22	
26.	Los Angeles-Mexico via San Bernardino	11.22		6.56	
27.	El Centro-Yuma	19.95		20.44	
28.	Redding-Nevada Line via Alturas	0.06		4.11	
29.	Peanut-Nevada Line near Purdy's	11.45		12.66	
31.	Colton-Nevada State Line	10.00		3.55	
32.	Route 56, Watsonville-Route 4 near Califa	6.98		0.22	
33.	Route 56 near Cambria-Route 4 near Famoso	10.52		8.12	
34.	Route 4 at Galt-Route 23 at Pickett's Junction	16.02		7.15	
35.	Route 1 at Alton-Route 20 at Douglas City	2.54		2.38	
37.	Auburn-Truckee	23.61		17.15	
38.	Route 11 at Mays-Nevada Line via Truckee River	11.67		21.91	
39.	Route 38 at Tahoe City-Nevada State Line	4.55		0.47	
40.	Route 13 near Montezuma-Route 76 at Benton	8.68			3.95
41.	Route 5 near Tracy-Kings River Canyon via Fresno	7.81			0.45
42.	Redwood Park-Los Gatos	4.05		12.08	
43.	Route 60 at Newport Beach-Route 31 near Victorville	2.86		1.94	
44.	Boulder Creek-Redwood Park	0.00			6.66
45.	Route 7, Willows-Route 3 near Biggs	25.55		13.59	
46.	Route 1 near Klamath-Route 3 near Cray	121.17		49.06	
47.	Route 7, Orland-Route 29 near Morgan		6.45	0.90	
48.	Route 1 north of Cloverdale-Route 56 near Albion		4.08	7.38	
49.	Napa-Route 15 near Sweet Hollow Summit	16.61		5.66	
50.	Sacramento-Route 15 near Wilbur Springs	3.17			10.96
51.	Route 8 at Shellville-Sebastopol	12.76		4.53	
52.	Alto-Tiburon	53.25		27.03	
53.	Route 7 at Fairfield-Route 4 near Lodi via Rio Vista	21.82		25.90	
54.	Route 11 at Perkins-Route 65 at Central House	21.85		23.92	
55.	Route 5 near Glenwood-San Francisco		3.03	14.88	
56.	Route 2 at Las Cruces-Route 1 near Fernbridge	4.24		5.01	
57.	Route 2 near Santa Maria-Route 23 near Freeman via Bakersfield	12.90		1.74	
58.	Route 2 near Santa Margarita-Arizona Line near Topock via Mojave and Barstow	21.44		20.25	

Route	Termini	1951 Percent gain or loss Sunday Gain	Sunday Loss	Monday Gain	Monday Loss
59.	Route 4 at Gorman-Route 43 at Lake Arrowhead	8.84		8.00	
60.	Route 2 at Serra-Route 2 at El Rio	7.24		7.73	
61.	Route 4 south of Glendale-Route 59 near Phelon	0.8			0.28
62.	Route 171 at Northam-Route 61 near Crystal Lake	23.29		24.10	
63.	Big Pine-Nevada State Line		21.72		33.82
64.	Route 2 at San Juan Capistrano-Blythe	15.33		11.34	
65.	Route 18 near Mariposa-Auburn	12.17			0.33
66.	Route 5 near Mossdale-Route 13 near Oakdale	10.17		0.45	
67.	Pajaro River-Route 2 near San Benito River Bridge		0.76		3.26
68.	San Jose-San Francisco	2.20		3.82	
69.	Route 5 at Warm Springs-Route 1, San Rafael		0.01	3.18	
70.	Ukiah-Talmage	5.16		18.50	
71.	Crescent City-Oregon Line	7.02		6.49	
72.	Weed-Oregon Line	5.24		9.32	
73.	Route 29 near Johnstonville-Oregon Line	6.83		6.86	
74.	Napa Wye-Cordelia via Vallejo and Benicia	14.56		18.48	
75.	Oakland-Junction Route 65 at Altaville		0.22	7.91	
76.	Route 125 at Shaw Avenue-Nevada State Line near Benton	3.87		6.32	
77.	San Diego-Los Angeles via Pomona	13.45		10.06	
78.	Route 12 near Descanso-Route 19 near March Field	9.17		10.41	
79.	Route 2, Ventura-Route 4 at Castaic	9.19		10.33	
80.	Route 51, Rincon Creek-Route 2 near Zaca		0.02	6.16	

Stover Retires

Continued from page 61 . . .

opportunity to observe under actual conditions of use, the various structures built by both the State and the counties. Many of these structures, built during the early horse and buggy days, were inadequate to carry the ever increasing loads and volume of traffic that developed through the years. The problems of strengthening and widening the more hazardous of these structures with the available funds required considerable ingenuity and became more and more of a problem as the wartime shortage of needed materials became more acute, while at the same time, the size and number of overloaded trucks greatly increased.

It is a credit to Mr. Stover's engineering ability that during these critical years, not a single bridge failure occurred on the State Highway System.

During the past three years, Mr. Stover has been engaged on special studies and investigation of various bridge problems. Among these are studies of the effect of present day traffic on thin slab bridge decks.

Upon retirement, Harvey plans to spend a good part of the time during the summer months at his cabin on Lake Tahoe, and hunting and fishing in the high Sierra country. During the rest of the year, he will reside in Sacramento where he will be available for consultation on special engineering and bridge problems.

California Autos Exceed 5,000,000

Automobile registration in California already exceeds the 5,000,000 mark; there is one car for every two persons in the State; the national ratio is one car for every four persons.

Yet despite heavy user traffic, California's highway development program is not keeping pace with the population growth and the competition for public money for a multitude of other governmental services. Out of 14,000 miles of state highways in California, 11,300 miles or 81 percent show deficiencies of one kind or another.

The need for accelerated highway modernization, the problems confronting adequate highway finance, increasing demands for freeways and limited access roads, the limitations imposed by material shortages—are all factors commensurate with today's motor vehicle requirements.

SQUEALING TIRES

When automobile tires squeal on curves, excessive speed may be the cause rather than under-inflation. Good drivers reduce their speed before reaching a curve, then accelerate the car gradually through the curve. This procedure prevents tire squeal and provides better control over the car.

Civil Defense

Continued from page 35 . . .

emergency organization in each division, and in each instance the results have been eminently satisfactory. Several months ago there was a fire at San Quentin Prison, and literally before the smoke had disappeared, there was a damage survey team from the Division of Architecture on the scene. The work they performed was done in such a manner that the Director of Corrections commended their efforts to the Director of Public Works.

During the floods of a year ago—higher stages of water than for many years previous—the Division of Water Resources predicted the crests and when they would occur to such exactness, that damage was greatly lessened and the human injury factor greatly reduced. The Division of Highways maintenance crews also proved their mettle during these floods, by the manner in which they restored blocked highways to use, and re-routed traffic during the emergency periods.

At the present time the development of detailed plans for certain expected conditions is of tremendous importance. Through this medium, we can evaluate the needs of each region as related to the local relief and emergency forces, thereby determining our immediate course of action when "disaster strikes."

In case we do have a state of extreme emergency, the Department of Public Works will show a hard core of coordinated effort, with a tested force of experts to lend aid to any stricken area. Representative engineers from the operating divisions on the staff of the Chief of Engineering Service will help evaluate problems at the state level, and offer their knowledge of the ability of our forces to meet any given need. In the field our engineers and other personnel will promptly translate plans into positive action to save lives and property. The Department of Public Works will meet the challenge because the flexibility and adaptability of our operation is a proven historic attribute of our entire organization.

Shell Beach Study

Continued from page 39 . . .

volume drops, while the other four registered gains. Nine of the 13 businesses on the same side of the highway in Pismo Beach disclosed business declines and establishments on the easterly side of the highway had five out of nine showing declines.

Since we do not have available business volume figures on the one other type of popular roadside business—motels—of which there are three in Shell Beach, and interview reports were quite varied, a volume comparison was not made. However, the fact that the majority of motels in the vicinity are located near the beach rather than directly abutting the highway indicates that highway frontage is secondary to the proximity of the beach. In the town of Pismo Beach almost all motels are located near the ocean and are considerably removed from the highway.

Since direct entry from the highway in this area does not appear to be of prime importance and since all the motels cater to the tourist and vacationist classes of clientele, it appears likely that the effects of the expressway construction, which enforced some circuity of travel upon prospective motel customers, were slight.

Commercial Land Values

Commercial lot values in Shell Beach have changed very little since 1947. However, the fact that these properties no longer have direct access to the through traffic lanes does not appear to be the dominant reason for the failure of commercial values to keep pace with residential values. Probably one of the two most important factors was the fact that Pismo Beach, located just one mile southerly, already had complete shopping facilities available to serve Shell Beach residents as well as tourists. The other factor is the unfavorable ratio of the number of commercial lots to the number of residential lots in the community. There are 126 lots available for commercial uses, while the maximum number of residential lots is 922. These factors resulted in a supply considerably above the reasonable need.

While Shell Beach commercial lots have remained relatively low valued due to the over-supply, several new businesses have been built since the expressway construction began. These new businesses of types catering almost entirely to local residents, include a building supply, a gift shop, a dry cleaning business, a barber shop, a plumbing shop, and a malt shop. These represent a 30 percent increase in Shell Beach commercial enterprises since the highway construction.

Conclusions

The study of the effects of the expressway benefits to Shell Beach is exceptionally valuable because the absence of other factors attributes the town's suddenly accelerated growth rate almost entirely to the improved safety and comfort and time-saving, which encouraged many of the commuters desiring seaside living to move there.

In California, where more and more city workers are choosing to reside in suburban and rural communities, the adequacy of highway facilities is a prime consideration in determining whether or not a subdivision will be publicly accepted. The Shell Beach study has shown precisely the importance of controlled access, multilane highways to the development of small communities—an importance undoubtedly applicable to any subdivision in competition with other areas. As in the case of Shell Beach, the highway improvement actually may mean the difference between success and failure.

Traffic Engineering

Continued from page 58 . . .

Design Department Problem

A problem which was troubling our Design Department concerned transitions from two-lane to four-lane divided highways. This was made the subject of a special study, and a satisfactory standard design for such transitions was developed and is now in use.

A study of accident rates as related to shoulder widths was completed by the Traffic Department and has resulted in a crystallization of standards for over-all roadbed width on two-lane roads under varying volume conditions.

Another research project which stimulated considerable interest throughout the Nation was a study of lower case letters as compared to capital letters for highway signs. For some time, California had been making some use of lower case letters on large overhead illuminated directional signs on freeways. These signs were apparently readily accepted by the general public; at least there was no visible reaction by the layman. Traffic engineers, however, were not so ready with their acceptance, so a research project was set up to compare legibility and word recognition qualities of lower case and capital letters for this type of highway sign. This study was made in cooperation with the Institute of Transportation and Traffic Engineering of the University of California, and the results of the study were reported at the annual meeting of the Highway Research Board in December of 1950. Lower case letters are now standard in California for all overhead directional signs on freeways and expressways.

Recognition

Three times in the past four years California has been awarded first place for traffic engineering achievement in the Annual National Safety Contest sponsored by the National Safety Council. In 1947 and 1948 California was grouped with the Eleven Western States and took first place both years. In 1949 and 1950 California was placed in competition in the National Safety Council's Group 5, which consists of the eight states whose population and motor vehicle registration are comparable to each other, and in this competition California took second place in 1949 and captured the first place award in 1950.

In the 13 years since its birth in California, traffic engineering has made great strides. It has now gained recognition, not as a necessary evil, but as a useful and essential branch in the over-all field of highway engineering.

PEDESTRIAN COURTESY

Let pedestrians have the right of way always. This is courteous driving and good manners make good drivers.

EARL WARREN
Governor of California

FRANK B. DURKEE
Director of Public Works

HIGHWAY COMMISSION

HARRISON R. BAKER	Pasadena
H. STEPHEN CHASE	Sacramento
JAMES A. GUTHRIE	San Bernardino
F. WALTER SANDELIN	Ukiah
CHESTER H. WARLOW	Fresno
CHARLES T. LEIGH	San Diego
R. C. KENNEDY, Secretary	Sacramento

DIVISION OF HIGHWAYS

GEO. T. McCOY	State Highway Engineer
R. M. GILLIS	Deputy State Highway Engineer
CHAS. E. WAITE	Assistant State Highway Engineer
EARL WITHYCOMBE	Assistant State Highway Engineer
F. W. PANHORST	Assistant State Highway Engineer
J. W. VICKREY	Assistant State Highway Engineer
R. H. WILSON	Assistant State Highway Engineer
F. N. HVEEM	Materials and Research Engineer
GEORGE F. HELLESOE	Maintenance Engineer
E. T. TELFORD	Engineer of Design
DON G. EVANS	Construction Engineer
H. B. LA FORGE	Engineer of Federal Secondary Roads
L. V. CAMPBELL	Engineer of City and Cooperative Projects
EARL E. SORENSON	Equipment Engineer
H. C. McCARTY	Office Engineer
J. C. YOUNG	Traffic Engineer
J. C. WOMACK	Planning Engineer
J. P. MURPHY	Principal Highway Engineer
E. J. SALDINE	Principal Highway Engineer
I. O. JAHLSTROM	Principal Bridge Engineer
STEWART MITCHELL	Principal Bridge Engineer
E. R. HIGGINS	Comptroller

Right of Way Department

FRANK C. BALFOUR	Chief Right of Way Agent
E. F. WAGNER	Deputy Chief Right of Way Agent
GEORGE S. PINGRY	Assistant Chief
R. S. J. PIANEZZI	Assistant Chief
E. M. MacDONALD	Assistant Chief

District IV

JNO. H. SKEGGS	Assistant State Highway Engineer

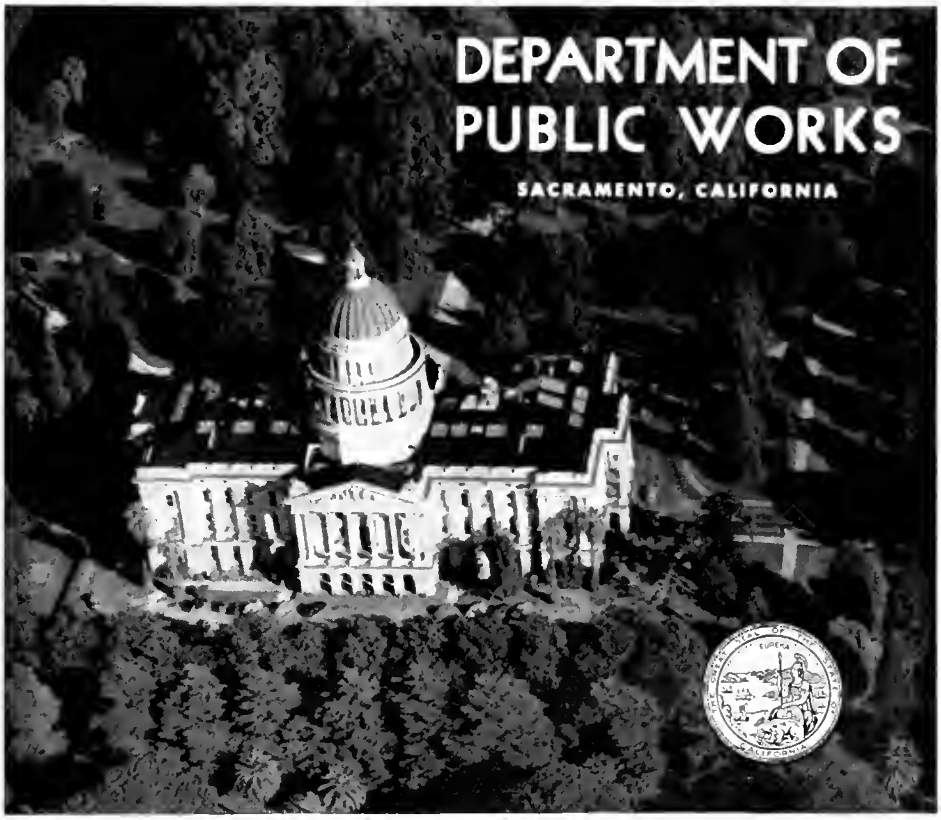
District VII

ARDING	Assistant State Highway Engineer

DIVISION OF HIGHWAYS

District Engineers

A. M. NASH	District I, Eureka
W. TRASK	District II, Redding
CHARLES H. WHITMORE	District III, Marysville
B. W. BOOKER	District IV, San Francisco
L. A. WEYMOUTH	District IV, San Francisco
E. J. L. PETERSON	District V, San Luis Obispo
E. T. SCOTT	District VI, Fresno
W. L. FAHEY	District VII, Los Angeles
M. E. CESSNA	District VII, Los Angeles
S. W. LOWDEN	District VIII, San Bernardino
ALAN S. HART	District IX, Bishop
JOHN G. MEYER	District X, Stockton
E. E. WALLACE	District XI, San Diego
HOWARD C. WOOD	Bridge Engineer, San Francisco-Oakland Bay Bridge and Carquinez Bridge



DIVISION OF CONTRACTS AND RIGHTS OF WAY

Legal

ROBERT E. REED	Chief
GEORGE C. HADLEY	Attorney
HOLLOWAY JONES	Attorney

DIVISION OF SAN FRANCISCO TOLL CROSSINGS

NORMAN C. RAAB	Project Design Engineer

DIVISION OF WATER RESOURCES

A. D. EDMONSTON	State Engineer, Chief of Division
G. H. JONES	Assistant State Engineer, Sacramento River Flood Control Project, Supervision of Safety of Dams, Sacramento-San Joaquin Water Supervision
T. B. WADDELL	Assistant State Engineer, Water Resources Investigations, Central Valley Project, Irrigation Districts
GORDON ZANDER	Assistant State Engineer, Water Rights and Water Quality Investigations
MAX BOOKMAN	Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER	Principal Attorney
T. R. MERRYWEATHER	Administrative Assistant

DIVISION OF ARCHITECTURE

ANSON BOYD	State Architect
H. S. HUNTER	Deputy Chief
ROBERT W. FORMHALS	Administrative Assistant to State Architect
EARL W. HAMPTON	Supervisor of Contract Architects

Administrative Service

W. K. DANIELS	Assistant State Architect, Administrative
WADE O. HALSTEAD	Principal Estimator of Building Construction
CARLETON PIERSON	Supervising Contracts Writer

Planning and Design Service

P. T. POAGE	Assistant State Architect, Design and Planning
A. F. DUDMAN	Principal Architectural Designer
CARL A. HENDERLONG	Principal Mechanical and Electrical Engineer
C. L. IVERSON	General Supervising Architectural Draftsman
ELLIOTT ADAMS	Architectural Property Analyst
WALTER E. LORD	Supervising Specifications Writer
JAMES A. GILLEM	Supervisor Area III (Los Angeles)

Construction Service

D. C. WILLETT	Chief Construction Engineer
F. A. JOHNSON	Principal Structural Engineer
JOHN S. MOORE	General Construction Superisor
NATE W. DOWNES	Supervising Engineer of Maintenance and Operations

Area Construction Supervisors

THOMAS M. CURRAN	Area I, Oakland
W. H. EPPERSON	Area II, Sacramento
FRANK R. AUSTGEN	Area III, Los Angeles

Area Structural Engineers, Schoolhouse Section

C. M. HERD	Area I, San Francisco
M. A. EWING	Area II, Sacramento
H. W. BOLIN	Area III, Los Angeles

printed in CALIFORNIA STATE PRINTING OFFICE 51887 11-51 30M

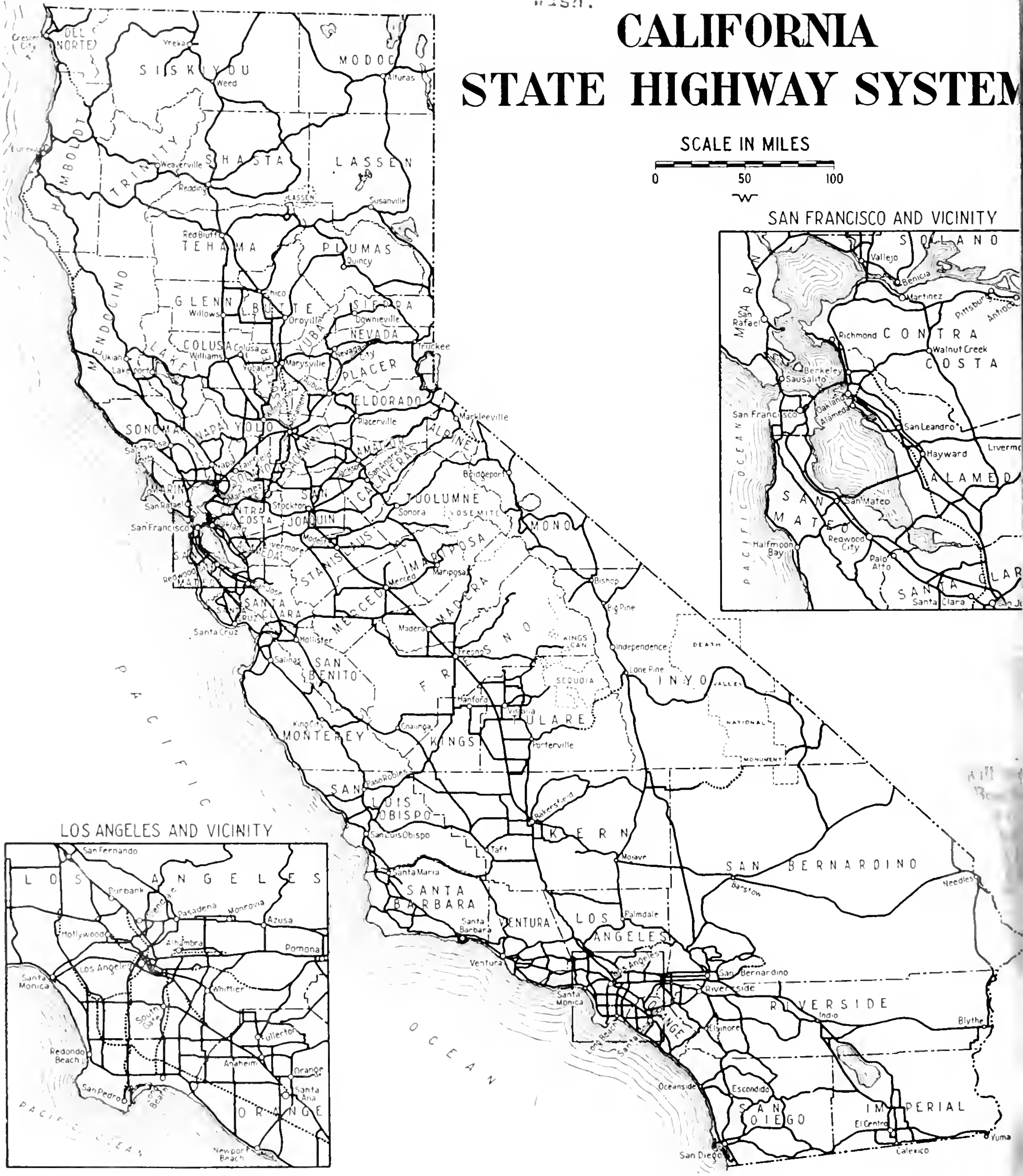
California Highways and Public Works
DIVISION OF HIGHWAYS
P. O. Box 1499
SACRAMENTO, CALIFORNIA

RETURN POSTAGE GUARANTEED

Seattle Public Library,
Seattle,
Wash.

SEC. 34.66 P. L. &
U. S. POSTAGE
PAID
Sacramento, Cal.
Permit No. 152

CALIFORNIA STATE HIGHWAY SYSTEM



Sept 1951